JOURNAL OF

ENGINEERING EDUCATION

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THE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

JANUARY, 1960 Vol. 50, No. 4

new...and coming

ENGINEERING ECONOMY, Third Edition: E. PAUL DeGARMO, *University of California, Berkeley*

Specially designed for engineering students, this book contains new chapters on basic economy study patterns, handling incomes and cost data, income tax effects, and public utilities; new problems and illustrations; new tables covering interest and annuity factors for higher interest rates; and MAPI replacement procedures covered in separate appendix. *January, 1960*

DESIGN OF MODERN STEEL STRUCTURES, Second Edition: L. E. GRINTER, *University of Florida*

Discussing and illustrating the design of both steel and wood structures, the author presents basic concepts in the simplest manner possible. *Required:* an understanding of statics, strength of materials, and the theory of structure. *New:* important material on ultimate-load design or plastic design of continuous beams and frames; this material is separated from specification design to allow introduction at either undergraduate or graduate level. Latest specifications. *March, 1960*

HEAT TRANSFER: ALAN CHAPMAN, *The Rice Institute*

This textbook for advanced students discusses conduction, convection, and radiation, explaining the applications of these basic concepts to the solution of important heat transfer processes. Included: treatment of extended surfaces problems and a discussion of physical properties significant in heat transfer. *April, 1960*

ENGINEERING The Profession and Elementary Problem Analysis, Second Edition of *Elementary Problems in Engineering:* H. W. LEACH, *Bell Helicopter Corporation, Hurst, Texas,* and GEORGE C. BEAKLEY, *Arizona State University*

This revised text emphasizes the analytical approach to problem solutions. Also stressed is the idealized model system which is introduced early and used throughout the book. There are new chapters on unit systems and the engineering method of problem analysis; an expanded chapter on graphs, graphical solutions, and curve plotting; new illustrations; and 1100 new problems. *March, 1960*

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FELLOWSHIPS IN HIGHER EDUCATION

The University of Michigan through its Center for the Study of Higher Education will again offer fellowships for the academic year 1960–61. They are of two types: (1) The Michigan Fellows in College Administration, five in number, devote the year to study, internships, research and other experiences that are intended to help prepare them for college and university administration. On a postdoctoral basis, or equivalent, the fellowships cover living and incidental expenses up to a maximum of $8,000. (2) The graduate fellowships in higher education are for predoctoral students who need assistance in completing the degree and who show promise of contributing to research on the problems of higher education. They vary in amounts from $1,000 to $3,000, depending upon need.

Applicants for either type of fellowship should be under 40 years of age. Application forms and a circular descriptive of the program may be secured from the Center for the Study of Higher Education, The University of Michigan, Ann Arbor. The deadline for applications is February 1.

The program at Michigan is supported by a grant of funds from the Carnegie Corporation of New York. The Michigan Fellows in College Administration who were given awards in previous years are now in such positions as Assistant to the President, Dean of Students, Dean, and President. The institutions include junior colleges, private liberal arts colleges, and state colleges and universities.

DO YOU KNOW . . . .

► . . . . That some interesting comments were made at the recent Assembly of the International Council for Philosophy and Humanistic Studies? "Science is not the work of the devil or of God, it is the work of man. I know many humanistic scientists, but few scientific humanists"—Joshua Whatmough. "Science is felt to be anti-humanistic, but the study of science actually is humanistic. The great humanists of the past were just as interested in science as in the arts"—George Boas. "Culture has been divided into the Humanities and Science, and the humanities must attempt to resolve this conflict. We (the humanists) should tie ourselves to science and should not be on the defensive"—Frederick Burkhardt. "Humanists have not adapted their studies to the great new scientific knowledge or to the new kind of students coming to the universities. These students are more interested in metaphysics and ethics than any group before them. The greatest revolutions in the world were not caused by the scientists, but by humanists which produced a climate in which scientists could arise"—Sir Charles Webster.

► . . . . That Dr. Edward Teller was quoted in an AP dispatch as follows? "I think we should recognize, all of us, that in this technological age a person cannot be called educated if he does not understand at least in general terms the laws of what God has created. And if he does not understand the changes that we men have made in this world around us, by the remarkable achievements of technology, he is not going to guide our future in the right way."

► . . . . That the Electrical Engineering Division of ASEE has cooperated with the IRE professional group on microwave theory and techniques in sponsoring a one-day "Tutorial Session on Plasmas" during the Northeast Electronics Research and Engineering meeting in Boston? This is the first such effort on the part of the EE Division and it is to be commended for initiating such activity. Also, this is the very sort of cooperative planning and programming that all Divisions are urged to undertake.

► . . . . That ASEE through its Civil Engineering Division has a joint committee with the Association of General Contractors? In the report of the AGC Education Committee, September 1959, it is recommended that the following statement be adopted, "It is the concensus of the opinion of the Associated General Contractors of America that the needs of the construction industry can best be served by a course of study consisting of a basic engineering curriculum (which meets the minimum requirements of the Engineers' Council for Professional Development) plus courses pertaining to education for construction management."

► . . . . That the papers presented at the Engineering Economy Division's summer school at Pittsburgh last June now are available? Place your order with The Engineering Economist, Stevens Institute of Technology, Hoboken, New Jersey, Attention: Mrs. Laura Corridon. The price is $4.00 per copy to members of ASEE and AIIE, non-members who attended the symposium, educators, schools, and public libraries; to all others the cost is $10.00.

► . . . . That the Mid-Winter Meeting of the Co-op Division will be on February 11 and 12 instead of January 14 and 15? The reason for the change is that the report of the "Self Study Committee on Cooperative Education" will not be earlier, and it is the basis of the entire program. Georgia Tech in Atlanta still is the place.

► . . . . That RWI has prepared a manual for "local section" organizations? The "local section" idea is a recent development and the manual is intended as an aid in developing a higher interest in engineering education (particularly in major industrial areas), to get industrial members better integrated into the work of the Society, and to increase industry

participation in Section meetings. Additional information can be obtained from the RWI officers. The study of professional climate is being continued by RWI by trying to determine who is responsible for its development. Professors with considerable experience in industry, consulting engineers, recent graduates, and engineering deans are to be consulted in the attempt to answer the question. The results of the study will be related to NSPE's study of "What is Professional Status?"

► . . . . That the final report of the National Survey of Technical Institute Education is being published as a unit in the "Carnegie Series in American Education" by the McGraw-Hill Book Company, Inc.? The book, now available, is a composite of some 8 man-years of work by 155 college, industry, and professional people who served on national and regional committees plus the collaborative participation of 190 educational institutions, 96 of which in 39 states were visited by a team, and 143 representative industrial enterprises in 25 states, all of which were visited by a team. The report will serve as the starting point for ASEE's Committee on Evaluation of Technical Institute Education.

► . . . . That a new Society called the American Society for Heating, Refrigerating, and Air-Conditioning Engineers is a consolidation of the American Society of Heating and Air-Conditioning Engineers and the American Society of Refrigerating Engineers? The consolidated Society has a membership of more than 18,000, the President is Cecil Boling of West Hartford, Conn., and A. V. Hutchinson is the Executive Secretary.

► . . . . That A. C. Blackman is the new managing director of the American Society for Safety Engineers? He formerly headed California's Division of Industrial Safety. ASSE has a worldwide membership of more than 7,000 safety engineers, "dedicated to upholding the standards of their profession and using their abilities for human service in the nation, state, and community."

► . . . . That a handbook to assist member companies in the development and evaluation of programs designed to increase the number of engineers and scientists has been developed by the Institute of Aeronautical Sciences? Financial and non-financial aid to colleges and youth motivation are among the topics discussed.

► . . . . That the Oak Ridge Institute of Nuclear Studies recently dedicated its new $250,000 administration building in Oak Ridge? This is the first non-government owned facility to be occupied by the Institute, which now owns a 38-acre tract. ORINS is a non-profit educational corporation of thirty-seven southern universities operating under direct contract to the Atomic Energy Commission. Several outside organizations contributed funds toward the construction of the building.

► . . . . That the University of Pennsylvania awarded $1,000 each to twenty faculty members for excellence in undergraduate teaching? The awards are made to those having the rank of associate professor or below, and who, in the assessment of their colleagues, have particularly distinguished themselves in the teaching profession. Three of the 20 are in engineering.

► . . . . That the National Defense Education Act authorizes three million dollars for the first year and five million dollars for each of the three succeeding years to support research projects in educational television, radio and motion pictures, and related communications media? Applications for funds should be sent to the Director, Communications Media Research Program, Office of Education, Department of Health, Education, and Welfare, Washington 25, D. C. The Office of Education also sponsored a meeting of representatives of interested organizations for the purpose of designing a broad framework for research in this educational area.

► . . . . That the interest of colleges of engineering in NSF sponsored summer institutes has increased tremendously?

Last year only two were approved, each having three courses of study in the general pre-engineering area. This year some thirty proposals were submitted which pertain to engineering education, varying all the way from graduate study leading to degrees to programs for pre-engineering, technical institute, and high school teachers. See p. 297 for a brief description of the 10 offerings for the summer of 1960.

► . . . . That S. J. Tyler has retired as the Secretary of the Education and Accreditation Committee of ECPD? In the future that work will be handled by Miss Elsie Murray, the Administrative Secretary of ECPD. Congratulations, Steve, and best wishes for a second retirement.

► . . . . That a quick look at the results of the changes in ECPD accreditation of engineering curricula for the past year indicates a marked trend toward the elimination of options? The Sanitary Option in CE leads the list with 16 deletions; Aero and Industrial Options in ME were next, with 6 and 5 deletions, respectively. A total of 9 curricula and about 43 options were discontinued, only 3 options were added, and one curriculum was changed to an option. Added curricula numbered about 17, 4 being in ChE, 3 in Science Engineering, and 2 in CE.

► . . . . That ,EJC has received a grant of $34,000 from the National Science Foundation for the conduct of a survey to determine the suitability and feasibility of establishing an expanded National Engineers Register. It is intended that the Register to be established will be an integral part of the "Survey of the Engineering Profession" which seemingly has bogged down after much initial enthusiasm. S. C. Hollister has been named Chairman of the Committee to make the study. The employment of a Study Director also has been authorized.

► . . . . That last August, President Eisenhower signed into law a bill providing for recognition of individuals who make outstanding contributions to science and engineering? NSF is responsible for the design of the medal and the National Academy of Sciences is the prime source of recommendations to the President for candidates from fields of physical, biological, mathematical, and engineering sciences. It is expected that EJC's Honors Committee will insure that qualified engineering candidates are nominated for consideration.

► . . . . That campus residence students who studied entirely independently —without teachers and classmates— achieved more knowledge than those taught by conventional classroom methods or those meeting regularly in small groups without instructors? The same study indicates that a group of teachers receiving in-service training in the same subject performed very poorly under conditions of independent study. The reason for this difference apparently is that those who have had prior professional experience tend to be more narrowly selective of the things they are willing to learn. In general, they want credit toward some professional advancement, plus any ideas or skills which appear concretely practical and applicable in the light of their job experience. These are some of the ideas reported in a University of Michigan School of Education program. Has anyone tried a similiar idea in engineering?

► . . . . That American "Degree Mills" calling themselves "Colleges or Universities" perhaps having as many as 750,000 students take in an estimated $75,000,000 per year? From $50 to $1,000 is required to get a degree, even a Ph.D. and diploma to prove it, often without any study. Many of the "students" are from foreign countries and the racket is doing U. S. education much harm. The complete story is in ACE's new report selling for $1.00.

► . . . . That the 1960 Annual Meeting is at Purdue University on June 20–24!

W. LEIGHTON COLLINS
Secretary

Annual Meeting—at the Crossroads

Purdue for ASEE in 1960

In fact as well as in motto, Indiana is the "crossroads of America." Rich in history, diversified in both industry and agriculture, abounding in recreational facilities, and criss-crossed by a network of modern transportation facilities, Indiana provides a varied and interesting aspect for the visitor. Purdue University, site of the 1960 Annual Meeting of the American Society for Engineering Education, is located in Lafayette, a historic city in the northwestern part of this centrally and strategically located state.

Indiana was the second state carved out of the old Northwest Territory, and was admitted to statehood in 1816 as the nineteenth state of the Union. Its history provides a representative pageant in the development of the nation. Among reminders of the state's pre-history are earthworks left by the vanished race of mound-builders and relics of Indian tribes, including the Delawares, the Miamis, the Kickapoos, and the Potawatomis.

The first exploration of Indiana by Europeans took place in 1670 when LaSalle and his expedition entered the state. They came in from the northeast, carried their boats over short portages at Fort Wayne and South Bend and followed the water courses to the southwest. The French established trading posts at Fort Wayne and Vincennes, which they held until 1760 when they were defeated by the British in the French and Indian War.

The city of Lafayette itself was founded in 1825, and was named after the Marquis de Lafayette. The city is four miles north of Fort Ouiatenon, the first white settlement in Indiana, built by traders in 1719. An 1826 act of the Indiana State Legislature established Tippecanoe County, of which Lafayette is the county seat. The name of the county commemorates the Battle of Tippecanoe, fought in 1811, in which General William Henry Harrison, future ninth President of the United States, decisively defeated the Indian Chief, Tecumseh. The battlefield is now a State Park located eight miles north of Lafayette.

With the passing of the western frontiers, Indiana began to assume its commercial, industrial, and agricultural importance. Characteristically mid-western, Indiana is, at the same time, closer to many eastern population centers than to the westermost points of the plains states. Because of this central location, Indiana has been able to maintain a stable balance between urban and rural living. It is today both a leading industrial state and a major agricultural state. Indiana is now the center of U. S. manufacturing and the center of the American market; 115 million people live within a 575 mile radius of the state.

The state's location, coupled with its abundant natural resources—soil, coal, forests, clays, stone, gypsum, natural gas and oil—contributes to Indiana's leading industrial position. It is, for example, one of the most important of the metal-working states. Plants of metal-working industries employ more than 6 out of every 10 persons engaged in the manufacturing in Indiana.

Among the most significant specific industries in Indiana are those manufacturing electrical equipment, iron and steel machinery, foods, furniture, apparel, paper products, chemicals, and many other products. In Lafayette itself, there are more than 50 industrial concerns engaged in the manufacture of metals, prefabricated homes, rubber, drugs, electrical equipment, paper, tools and other commodities.

Greater Lafayette, straddling the Wabash River, is in reality two incorporated cities which operate with the cooperation and singleness of purpose which make it into a single, unified community. La-

A view of the campus of Purdue University showing many of the major buildings which will be of interest to visitors attending the ASEE convention in June, 1960—1. Memorial Union. 2. Memorial Center. 3. John Purdue's grave. 4. Edward C. Elliott Hall of Music. 5. Civil Engineering. 6. Engineering Sciences. 7. Michael Golden Laboratories. 8. Electrical Engineering. 9. Mechanical Engineering. 10. Engineering Administration. 11. Chemical Engineering-Metallurgical Engineering. 12. Fieldhouse. 13. Men's Quadrangle. 14. H-1 Residence Hall. 15. H-2 Residence Hall. 16. H-3 Residence Hall. 17. Recreational Gym. 18. Hall-X. 19. Women's Residence Halls.

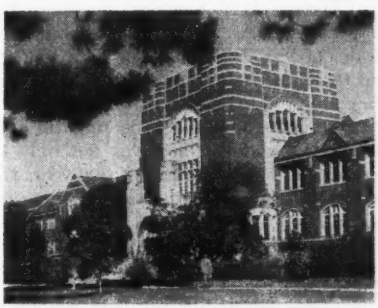
fayette is a city of some 40,000 residents; West Lafayette, the home of Purdue, has about 13,000.

Transportation

Indiana is easy to reach and to travel in by road, rail, or air. Lafayette itself is served by four major railroads: the Monon, the Wabash, the Nickel Plate, and the New York Central, and by Lake Central Airlines, which schedules six daily Indianapolis-Chicago flights to serve greater Lafayette. Sixty miles northwest of Indianapolis and 125 miles southeast of Chicago, Lafayette is easily accessible by a number of good modern roads, including U. S. 52 and 231, and Indiana roads 43, 25, and 26.

Recreation

The visitor to Purdue finds himself within easy driving distance of many state parks, beaches, and recreation areas. Among these are Turkey Run State Park, the Shades State Park, the famous Indiana Dunes State Park on Lake Michigan, Brown County State Park, Bass Lake, Shakamak State Park, and many others. In all, Indiana has 18 state parks, 2 state beaches, and 14 state memorials. Most of these recreation centers offer camping and cabin facilities, swimming, boating, fishing, picnic and play-ground



Memorial Union Building at Purdue University

View of the Memorial Center at Purdue University with the Oval in the foreground, where John Purdue, the founder of the institution, is buried. In the background, on the right, is the Memorial Union building, student center of the campus; and on the left the Wetherill Laboratory of Chemistry.

areas, and many other accommodations for the summer vacationer.

Fees for the use of these facilities are extremely attractive, ranging from 50 cents a day for camp sites which include water, tables, laundry, wood, etc., to between 15 and 35 dollars a week for family house-keeping cabins. Further information about these facilities may be obtained from the Indiana Department of Conservation, 311 West Washington Street, Indianapolis.

Among Lafayette's attractions for the visitor is renowned Columbian Park, containing a swimming pool, a stadium, tennis courts and playground, an amusement center, boating facilities on shaded lagoons, and perhaps the best small city zoo in the country. Your Purdue ASEE Women's Committee plans use of this park for the entertainment of children.

In addition to the many attractions of Purdue University itself, greater Lafayette offers community centers, art and historical museums, five golf courses, motion picture theaters, and two large lakes within a half-hour drive.

Subsequent articles will tell ASEE members about Purdue University and its facilities and, in particular, will provide information about its Engineering Schools and their programs.

ENGINEERING FOR INTERNATIONAL SERVICE

A new program in engineering for international service at Michigan State University may go a long way toward elminating some of the "Ugly American" criticisms of overseas projects. While the engineering student electing this program learns his specialty, he will also learn something about the language, history, economics, geography and politics of the country where he expects to work.

"Thousands of American engineers have gone overseas with little or no knowledge of the language, history and customs of the foreign nation," reports Dean John D. Ryder of M.S.U.'s College of Engineering. He points out that when the Russians send out technical assistants they speak the language and are familiar with the region where they are to work.

Michigan State's engineering for international service is a five-year program in which the engineer receives not only the bachelor of science degree but also the bachelor of arts. In the first two years the student takes the usual engineering courses. In the third, fourth and fifth years the remaining engineering courses are pursued along with liberal arts courses.

Students will specialize on one of the fields of engineering—agricultural, chemical, civil, electrical, mechanical or metallurgical—but will also take courses appropriate to the region of the world where they plan to work.

National Science Foundation Summer Institutes for Engineering Teachers

Financial aid will be available in 1960 for about 18,000 high school and college teachers of science, mathematics, and engineering to participate in Summer Institutes sponsored by the National Science Foundation. Three hundred and seventy-nine Institutes will be supported by NSF next summer, in 265 educational institutions. Of these, ten will be of direct interest to teachers of engineering, pre-engineering and technical institute courses.

Participants in the engineering Institutes will receive stipends of $75 per week for the duration of the Institutes, plus allowances for dependents and for travel. Participants will be chosen on a national basis by the Institutes themselves, not by the National Science Foundation. Inquiries and applications for participation should be addressed to the directors of the individual institutes. Each Institute will have formal application forms which may be obtained upon request from the Institute's Director.

The deadline for application is February 15. Stipend offers will be made by March 15, and the offers must be accepted or declined by April 1.

College Level Teachers of Engineering

Colorado State University. An Institute on fluid mechanics will be offered June 20–August 24 for college-level teachers of engineering. The work will be at the graduate level. Courses will be offered in heat transfer, intermediate fluid mechanics, mechanics of ideal fluids, hydraulic structures, experimental techniques in fluid mechanics, hydraulics of open channels, and wave mechanics. Each of the courses carries three quarter-credits which can be applied toward either an M.S. or Ph.D. degree. Each participant will take either three or four courses and will participate in a series of seminars.

Applications and inquiries should be addressed to Professor Milton E. Bender, Head, Department of Civil Engineering, Colorado State University, Fort Collins, Colorado.

Iowa State University. An Institute on the nature and properties of materials will be offered college-level teachers of engineering materials July 13–August 24. The program will include lectures, class work, and laboratories in solid state physics and engineering applications. Graduate credit up to eight quarter-credits may be obtained by qualified applicants.

The courses will be designed to fill the gap between the older descriptive work in properties of materials and the newer science of materials.

Applications and inquiries should be addressed to Professor Glenn Murphy, 212 Marston Hall, Iowa State University, Ames, Iowa.

Louisiana Polytechnic Institute. An Institute in mathematics and engineering sciences will be offered college teachers of engineering June 5–August 8. The Institute will stress the solving of engineering problems on high speed electronic digital computers. Lectures will be given on selected topics in mathematics, programming of digital computers, and applied problems which can be solved on such computers. The lectures on mathematics will deal with selected subjects on numerical analysis, linear programming, and matrix algebra. Nine semester hours of graduate credit may be earned by qualified participants.

Applications and inquiries should be addressed to Professor Melvin A. Nobles, Department of Petroleum and Geological Engineering, Tech Station Box 622, Ruston, Louisiana.

Oklahoma State University. A nine week Institute will be offered June 6–August 5 on the principles of structural analysis and soil mechanics for college teachers of civil engineering. The Institute will be on a seminar basis and will

deal with structural analysis, soil mechanics, and fluid mechanics. Nine semester hours of credit can be earned toward graduate degrees in civil engineering.

Applications and inquiries should be directed to Professor Jan J. Tuma, Head of Civil Engineering, Oklahoma State University, Stillwater, Oklahoma.

Stevens Institute of Technology. An Institute will be offered college teachers of engineering July 11–August 20. The objectives will be to provide a strict development of the two fundamental laws of thermodynamics and their consequences, to develop skills in thinking in terms of thermodynamics in dealing with engineering problems, and to develop an understanding of the behavior of materials as a logical consequence of the interaction of the atomic and molecular structure of the material with the environment in which it is used. Two closely coordinated courses will be offered, one in thermodynamics and the other in the structure of materials. Participants will be required to enroll for both courses. Five semester hours of graduate credit can be earned.

Applications and inquiries should be addressed to Professor Robert H. Seavy, Stevens Institute of Technology, Hoboken, New Jersey.

Junior College and Pre-engineering Teachers

Three Institutes will be offered for teachers in junior colleges, colleges not offering engineering degrees, and pre-engineering curricula.

Bucknell University. A six-week Institute will be offered June 27–August 5 on basic science in chemical engineering, basic science in civil engineering, basic science in electrical engineering, basic science in mechanical engineering. The major objectives of this Institute are to acquaint teachers of physics and pre-engineering with the uses made of basic science in the four major branches of engineering, and to give them an opportunity to study engineering science in an engineering school atmosphere, under the direction of engineering faculty members who have graduate degrees in their respective fields. All engineering laboratory facilities will be available for the Institute. Prominent engineering teachers, engineers, physics teachers, and physicists will present special lectures to the participants.

Three graduate credits may be earned for each of the four courses if so desired. Each participant will be required to pursue two of the four courses. Inquiries and applications should be addressed to Professor Charles H. Coder, Jr., Department of Mechanical Engineering, Bucknell University, Lewisburg, Pennsylvania.

Clemson College. An eight-week Institute will be offered June 13–August 6 for teachers of mathematics, physics, and basic engineering sciences in pre-engineering curricula. The Institute will include mathematics for engineers, physics for engineers, and a seminar on the major engineering fields.

This Institute is primarily for those teaching in junior colleges or in liberal arts colleges offering pre-engineering or 3–2 programs. It is particularly designed to help those who completed their own education some time ago and who will benefit from instruction in the latest developments in their fields, and for those who have good backgrounds and recent training but who need training at advanced levels to increase their grasp of their subject-matter. No credit will be offered.

Inquiries and applications should be addressed to Professor Robert W. Moorman, Department of Engineering Mechanics, Clemson College, South Carolina.

Kansas State College. An eight-week Institute will be offered June 13–August 6 for teachers of chemistry and physics in junior colleges and liberal arts colleges teaching pre-engineering students. The Institute will consist of three parts: basic chemistry of engineering material, basic physics of engineering research and development, and a seminar in the basic principles of engineering fields. This Institute will offer its participants the opportunity to become more familiar with the ways in which engineers make use of physics and chemistry and to review those fundamentals of physics and chemistry which are of most importance to engineers.

Applications and inquiries should be addressed to Professor L. C. Heckert, Kansas State College, Pittsburg, Kansas.

Technical Institute Teachers

Two Institutes will be offered specifically for teachers from technical institutes and from junior colleges offering technical institute type curricula.

Oklahoma State University. An eight-week Institute will be offered June 3–August 6 to teachers in technical institute type curricula who hold the B.S. degree or equivalent. Four courses will be offered: advanced electric networks (3 semester hours' credit), advanced electronics (3 semester hours' credit), higher technical mathematics (no credit), and seminars and study groups (no credit). The credit courses will be at a level above that normally covered in technical institutes. The mathematics course will be adapted to the needs of the participants.

Applications and inquiries should be addressed to Professor Hugh Lineback, Director, Technical Institute, College of Engineering, Oklahoma State University, Stillwater, Oklahoma.

University of Houston. An eight-week Institute will be offered June 27–August 19 for instructors in technical institutes and junior colleges offering technical curricula. Three courses will be offered each at the undergraduate and graduate levels. At the undergraduate level the courses are on differential equations, fundamentals of electronic and A-C circuits, and engineering analysis. At the graduate level the courses are on higher mathematics for science and engineering, electronic communication and control systems, and theoretical stress analysis. A maximum of six semester hours is available at either level if desired.

Applications and inquiries should be sent to Professor H. H. Curry, College of Technology, University of Houston, Houston, Texas.

FORD FOUNDATION PREDOCTORAL FELLOWSHIPS, LOANS

Engineering predoctoral fellowship-loan opportunities were established recently by the Ford Foundation at ten universities.* Their purpose is to increase the number of qualified engineering teachers by encouraging and accelerating education through the doctoral degree. The fellowship-loan program, for which $1.1 million has been earmarked over the next three years, is part of a series of grants announced by the Ford Foundation October 20 and November 16. Supplemental fellowships, forgivable loans, and combinations of the two are designed to make it financially possible for students to progress toward completion of a doctorate in engineering. Eligibility requirements are master's degree or its equivalent in engineering, the related sciences, or mathematics; admission as a graduate student with the avowed purpose of earning a doctorate in engineering; serious interest in teaching engineering in the United States or Canada; willingness to devote full time to doctoral pursuits; and likelihood of completing the doctorate by age 35. Criteria for selection are likelihood of the recipient's completing the doctorate and undertaking teaching in engineering within the next three years, and inability of the recipient to complete the doctorate and undertake a teaching career without fellowship and/or loan funds.

The university may make available a combination of fellowship funds, assistantship funds, and other income up to a maximum of $3,000 a year plus tuition. Fellowships from Foundation funds are not to exceed $2,000 a year. Paid non-degree work should not be such as to impede the student's full-time progress. In addition, a student may borrow up to $3,000 a year in forgivable loans if he needs additional support and has an annual income of at least $3,000 plus tuition from fellowships, assistantships and other sources that do not involve him in non-approved employment. "Need" is established by each institution.

Applications for this program should be made directly to the institution, not to the Foundation.

* California Institute of Technology, University of California (Berkeley), Carnegie Institute of Technology, Case Institute of Technology, University of Illinois, Massachusetts Institute of Technology, University of Michigan, Purdue University, Stanford University, and University of Wisconsin.

Fourth Annual Compilation of

Programs for Employing Faculty Members in Industry, Summer, 1960

Compiled by the Relations with Industry Division of the ASEE *

Intimate contact between educators and industry is essential to continued growth and development of modern technology. The Relations with Industry Division of ASEE is interested in exploring all possible means for contact which are beneficial.

One fruitful means for achieving this intimacy is by actual employment of college teachers in professional capacities in private industry and government laboratories. Extended full-time outside employment of faculties is prohibitive on any large scale because it involves costly relocation and serious interruption of the college programs. However, most professors are free to leave the campus occasionally during the summer months and find summers an excellent time to keep in touch with the industrial world and tackle current technical problems. They contribute fresh ideas to important company projects and gain new insight into the needs of industry.

They defend, or accept congratulations for, the graduates and curricula of their schools and higher education in general. The give and take with individuals who supervise or work with the graduating engineers, and are themselves products of our engineering colleges, helps the professor maintain his perspective. It also helps the individual engineers and administrators in industry understand the point of view and problems confronting colleges and their faculties. Warm friendships which frequently result are personally rewarding and of intangible but real benefit to both college and industry.

* Comments and supplementary or new information pertaining to this compilation should be addressed to C. E. Work, Michigan College of Mining and Technology, Houghton, Michigan.

As usual, this fourth annual compilation is divided into two categories according to the extent to which the industries make special efforts to show the professors the many facets of their businesses. Organizations listed in Part I arrange for planned tours of facilities and make other efforts to help familiarize the summer-hire professors with their methods and operations. Companies listed in Part II offer employment for the summer but leave primarily to the individual the initiative for gaining any familiarity with the organization beyond the unit in which he works.

In general, companies listed in Part II employ fewer professors, at least in any one location, than those listed in Part I. However, there are several notable exceptions. Where information is available, a rough approximation of how many faculty members may be hired in 1960 is given in parentheses with the name of the company.

It should be made clear, however, that careful efforts are made to match the qualifications of each applicant with a particular job assignment. It is not possible to predict accurately in August of 1959 what assignments will be available in June, 1960, or how they will correspond to the qualifications of the men who apply. Neither is it possible to predict the national or company's economic status so far in advance.

There are still other companies who offer summer employment that are not listed in this compilation. In some cases this is because the number of men they can employ is embarrassingly small compared to the number of applications they would receive if listed. Certain other companies' broad contacts in the schools

PART I. FORMAL PROGRAMS

Company (Name and Address)	Contact (Person and Position)	1 Backgrounds included	2 Length, weeks	3 Number of participants	4 Number of seminars	5 Other activities	6 Basis for payment	7 Other allowances
Allison Division General Motors Corporation Indianapolis 6, Indiana	R. C. Smith General Supervisor Salaried Personnel Dept.	Tech.	8–12	6–25	4	W	S	T
Boeing Airplane Company Seattle 24, Washington (Wichita, Kansas)	Fred Huleen Director of Personnel	Tech.	9–12	50	8	U, V, W	S	T, H
California Research Corp. 200 Bush Street San Francisco 4, Calif.	D. P. Krotz Asst. to the President	Tech.	8–12	2–5	—	U	Q	T
Chance Vought Aircraft Dallas, Texas	P. B. Cobb College Relations Representative	Tech.	8†	5	5	U, V	Q	T
Convair, Division of General Dynamics Corp. P. O. Box 1950 San Diego 12, California (Also divisions at Pomona, Calif. and Fort Worth, Texas)	H. T. Brooks College Relations Administrator	Tech.	8–12	15–50	2–5	U, V, W	Q	T
Douglas Aircraft Company Santa Monica, California	C. C. LaVene Employment Manager Engineering Division	Tech.	10†	12–45	—	U	Q	T
Hughes Aircraft Company Culver City, California	Leonard C. Silvern Scientific Education Engineering-General Offices	Tech.	12	70	24	U, V, W	S	T, F, H

† In order to obtain clearance, early application is required.

PART I. FORMAL PROGRAMS—*Continued*

Company (Name and Address)	Contact (Person and Position)	1 Backgrounds included	2 Length, weeks	3 Number of participants	4 Number of seminars	5 Other activities	6 Basis for payment	7 Other allowances
Humble Oil and Refining Co. Humble Building Houston 1, Texas	A. R. Rommel, Head Personnel Placement & Services Division Employee Relations Dept.	Tech. Non-Tech.	25–32	40–50	8	U, V	Q	T, H
International Business Machine Corporation 590 Madison Avenue New York 22, New York	R. E. Rodgers Manager, Professional and Technical Employment	Tech.	8–10	20–30	7	U, V, W	Q	T
Lockheed Aircraft Corporation Georgia Division Marietta, Georgia	Supervisor, Professional and Technical Placement	Tech.	9–13	15–25	6–8	U	Q	T
The Martin Company Baltimore 3, Maryland	J. J. Krajovic, Director College Relations	Tech.	9–12	50–70	2	U, V	S	—
The Martin Company Orlando, Florida	W. J. Powell, Jr. College Relations	Tech.	8–12	10–15	5	U, W	S	T
McDonnell Aircraft Municipal Airport St. Louis 3, Missouri	C. J. O'Toole Asst. Employment Manager	Tech.	12+	20–25	4	U, W	S	C
Minneapolis-Honeywell Regulator Company Minneapolis 8, Minnesota	Lachlan Reed Director, Industry-Education Relations	Tech.	8–14	5–20	5–10	U, W	S	T

PART I. FORMAL PROGRAMS—*Continued*

PART I. FORMAL PROGRAMS—*Continued*

Company (Name and Address)	Contact (Person and Position)	1 Backgrounds included	2 Length, weeks	3 Number of participants	4 Number of seminars	5 Other activities	6 Basis for payment	7 Other allowances
Minnesota Mining & Manufacturing Company Saint Paul 6, Minnesota	Wendel W. Burton Employment Manager 900 Fauquier Avenue	Tech.	8–10	5–6	1	U, V, W	S	T
North American Aviation, Inc. International Airport Los Angeles 45, California	J. A. Peart, Director Management Development and Training	Tech.	10–12	28	2–4	U, V, W	S	T
Pratt & Whitney Aircraft East Hartford, Connecticut	Charles T. Baker Engineering Department	Tech.	8–12†	20	6	U, V	S, Q	T
Public Service Electric and Gas Company 80 Park Place Newark 1, New Jersey	Herbert Wottrich Assistant to General Manager Electric Department	Tech.	8–12	5	4	U, W	Q	—
Radio Corporation of America Camden 2, New Jersey	Robert Haklish, Mgr. College Relations	Tech.	8–12	10–15	—	U	S	T
Sandia Corporation Sandia Base Albuquerque, N. M.	K. A. Smith, Manager Employment and Personnel Department	Tech.	10–12†	25–35	—	U, W	Q	T
Standard Oil Company (Ind.) Research Department Box 421 Whiting, Indiana	E. W. Adams Administrative Director Whiting Laboratories	Tech.	8–12	5–6	3	U, V, W	Q	T
Sun Oil Company Research & Engineering Dept. Marcus Hook, Pennsylvania	Robert A. Matteson Administrative Assistant	Tech.*	8–12	2–5	4–6	U, V	Q	—

* Only applicants from the area near the company's operation are considered for summer employment.

PART I. FORMAL PROGRAMS—*Continued*

Company (Name and Address)	Contact (Person and Position)	1 Backgrounds included	2 Length, weeks	3 Number of participants	4 Number of seminars	5 Other activities	6 Basis for payment	7 Other allowances
Headquarters, U. S. Army Chemical Center & Chemical Corps Material Command Army Chemical Center, Md.	Marion C. Sedberry Civilian Personnel Officer	Tech.	8–18†	10–15	—	U, V, W	Q	—
U. S. Army Ordnance Aberdeen Proving Ground Maryland	Civilian Personnel Officer	Tech.	8–12†	50–100	—	U	Q	—
U. S. Bureau of Reclamation Washington 25, D. C.	A. R. Golzé Assistant Commissioner	Tech.	8–12	5–10	—	U	Q	—
U. S. Navy Electronics Laboratory San Diego 52, California	Sidney W. Sandburg Employment Superintendent	Tech.	4–14†	5–12	6	U	Q	—
U. S. Naval Ordnance Test Station China Lake, California	R. C. Nelligan, Head Recruitment Branch (code 6521) Personnel and Community Relations Department	Tech.	12–14†	35	5–10	U	Q	—
U. S. Naval Research Laboratory Washington 25, D. C.	C. N. Mason, Jr. Head, Employment Branch Personnel Division	Tech.	8–12	10–15	—	U, V, W	Q	—
U. S. Steel Corporation 525 William Penn Place Pittsburgh 30, Pennsylvania	C. D. Feight Director, Employment	Tech.	9	10–20	9	U, V, W	S	T
Western Electric Company 195 Broadway New York 7, New York	E. J. Roach Coordinator of College Relations	Tech.	8–12	10–20	3	U, W	Q	—
Westinghouse Electric Company East Pittsburgh, Pennsylvania	R. Craig Fabian, Supv.	Tech.	12–14	20–25	1	U, V, W	R	T, F, H

enable them to fill any summer positions they have without further publicity. It is reassuring to observe the very large number of opportunities available to faculty members and the active interest shown by participating professors.

Part I. Formal Programs

Key to Symbols Used in Compilation Columns 4–7

4. Number of Seminars
   Seminar here means a conference to acquaint professors with some aspect of company policy, facilities, or activities.
5. Other Activities
   - U tours of facilities
   - V social and recreation
   - W luncheons etc. with company personnel

6. Basis for Payment
   - S college salary rate
   - Q Job assignment and qualifications
   - R honorarium or fixed stipend

7. Other Allowances
   - T travel
   - F food
   - H housing
   - C cost of living

Part II. Informal Employment

Company	*Contact*
Acme Steel Company * Chicago 27, Illinois	H. L. Bills, Vice-President and Director of Industrial Relations
Allis Chalmers Manufacturing Company Box 512, Milwaukee 1, Wisconsin	Paul A. Bierwagen, Supv., Graduate Studies Graduate Training Section
Aluminum Company of America Pittsburgh 19, Pennsylvania	W. J. O'Hare Manager of College Recruitment
American Viscose Corporation 1617 Pennsylvania Boulevard Philadelphia 3, Pennsylvania	William M. Nolan Recruitment Manager
Bethlehem Steel Company Bethlehem, Pennsylvania	A. M. Rupkey Manager of Personnel
Canadair, Limited * (3–5) P. O. Box 6087, Montreal, P. Q. Canada	A. C. Holden Engineering Services Supervisor
Caterpillar Tractor Company (3–5) Peoria, Illinois	M. D. MacLean, Professional and Technical Employment
Charleston Naval Shipyard U. S. Naval Base Charleston, South Carolina	Mr. H. W. Middlemas Head, Employment Division Industrial Relations Department
Chemstrand Corporation (1–5) Decatur, Alabama	A. D. Preston Technical Personnel Manager
Chicago Bridge and Iron Company 1305 W. 105th Street Chicago 43, Illinois	I. E. Boberg Vice President and Chief Engineer
Cleveland Electric Illuminating Co (1–3) P. O. Box 5000 Cleveland 1, Ohio	J. P. Fleming College Relations Coordinator

* Only applicants from the area near the company's operations are considered for summer employment.

50—No. 4 | T, F, H | R | U, V, W | 1 | 20–25 | 12–14 | Tech. | R. Craig Fabian, Supv. | Westinghouse Electric Company East Pittsburgh, Pennsylvania

Company	*Contact*
Continental Oil Company (1–8) P. O. Box 2197 Houston 1, Texas	Gerald F. Bassler, Director Personnel Development Industrial Relations Department
David Taylor Model Basin (5–10) † Washington 7, D. C.	S. Di Maria Personnel Officer
E. I. du Pont de Nemours & Co., Inc. Wilmington 98, Delaware	Dr. J. W. Reynard, Manager College Relations Section Personnel Division
Esso Research and Engineering Co. (4–6) P. O. Box 175, Linden, New Jersey	F. Senkowsky, Jr., Director Employee Relations
Ex-Cell-O Corporation P. O. Box 386 Detroit 32, Michigan	C. Edward Schumacher Training Manager
Food Machinery & Chemical Corporation Chemical Division 161 E. 42nd St., New York 17, N. Y.	A. J. St. Louis Recruitment Manager
Ford Motor Company 2000 Rotunda Dr., P. O. Box 2053 Dearborn, Michigan	Wilson A. Jones, Manager Industrial Relations
General Atomic Division of General Dynamics Corp. P. O. Box 608 San Diego 12, California	Henry Anthony Manager of Employment
General Electric Company (60–100) One River Road Schenectady 5, New York (and others)	W. Scott Hill Manager, Engineering Recruiting Engineering Personnel Service
General Motors Corporation General Motors Building 3044 West Grand Boulevard Detroit 2, Michigan	D. F. Waggoner, Director Salaried Personnel Placement
Hamilton Standard Division (2–3) United Aircraft Corporation Windsor Locks, Connecticut	W. E. Diefenderfer Engineering Manager
International Harvester Company (5–10) 180 North Michigan Avenue Chicago, Illinois	J. C. Shaw, Manpower Coordinator College Recruitment Education & Personnel Department
International Paper Company (2–4) Southern Craft Division Mobile 9, Alabama	Samuel W. Jenkins, Director College Relations and Professional Employment
Jones & Laughlin Steel Corporation 3 Gateway Center Pittsburgh 30, Pennsylvania	W. L. Witney, Director of Organizational Planning
Marquardt Aircraft Company (4–6) 16555 Saticoy Street Van Nuys, California	Don J. Colvin Recruitment Supervisor

† In order to obtain clearance, early application is required.

Company	*Contact*
Monsanto Chemical Company (5–10) 800 N. Lindburg Boulevard St. Louis 66, Missouri	Robert F. McCoole Technical Personnel Manager
Norden Division (5) United Aircraft Corporation Stamford, Connecticut (and others)	Thomas J. White Personnel Manager
Northern Illinois Gas Company (1–3) 615 Eastern Avenue Bellwood, Illinois	R. A. Lightbody Assistant Vice-President
Philadelphia Electric Company (2–3) 900 Sansom Street Philadelphia, Pennsylvania	G. W. Kaufmann, Jr. Director, Employment Division
Philco Corporation Philadelphia 34, Pennsylvania	Robert T. Love Coordinator, College Relations
Phillips Petroleum Company (1–5) Bartlesville, Oklahoma	D. R. McKeithan, Director Technical Manpower Division
The Pure Oil Company * 35 East Wacker Drive, Chicago, Ill.	J. J. Stadtherr Training Director
Ramo-Wooldridge Corporation P. O. Box 45215, Airport Station Los Angeles 45, California	Donald L. Pyke, Head Technical Staff Placement
Raytheon Manufacturing Company 1360 Soldiers' Field Road Brighton 35, Massachusetts (and others)	John B. Whitla College Relations Administrator
Republic Steel Corporation (10–15) Cleveland 1, Ohio (and other locations)	E. J. Magee Director of Industrial Relations
Rohm & Haas Company Philadelphia, Pennsylvania	Dr. J. S. Strong Office of Technical Employment 5000 Richmond Street
Scott Paper Company (1–3) Chester, Pennsylvania	Richard B. Miller Manager of Corporate Employment
Sperry Gyroscope Company Division of Sperry Rand Corporation Great Neck, New York	R. T. Hamlett, Director of Employment and Personnel Services
Sylvania Electric Products, Inc. 1740 Broadway, New York 19, N. Y.	Harris Reinhardt Manager, Organization Development
Toledo Edison Company * (2–3) Toledo, Ohio	Frank W. Keith, Director Employee Relations
United Aircraft Corporation Missiles and Space Systems Division (3–5) East Hartford 8, Connecticut	John W. North Engineering Department

* Only applicants from the area near the company's operations are considered for summer employment.

Company	*Contact*
United Aircraft Corporation Research Department (1–5) East Hartford, Connecticut	John G. Lee Director of Research
U. S. Army Engineer District † P. O. Box 1027 Detroit, Michigan	W. L. Cooper Civilian Personnel Officer
U. S. Army Engineer School † (3–5) Fort Belvoir, Virginia	Colonel Andrew V. Inge Director, Department of Non-Resident Instruction
U. S. Naval Air Development Center Johnsville, Pennsylvania	Mr. William Renz Industrial Relations Officer
U. S. Naval Air Material Center Naval Base Philadelphia 12, Pennsylvania	Mr. Joseph Hoydt Industrial Relations Officer
U. S. Naval Boiler and Turbine Laboratory Naval Base Philadelphia 12, Pennsylvania	J. M. Lipson, Head Administrative Department
U. S. Naval Engineering Experiment Station Annapolis, Maryland	Wilford E. Snyder Industrial Relations Officer
U. S. Naval Ordnance Laboratory † White Oak Silver Spring, Maryland	W. B. Wilkinson Employment Officer, Acting
U. S. Naval Radiological Defense Laboratory San Francisco 24, California	Joseph Zukor Employment Officer
U. S. Navy Mine Defense Laboratory Panama City, Florida	E. T. Castleberry, Sr. Civilian Personnel Officer
U. S. Navy Underwater Sound Laboratory Fort Trumbull, New London, Connecticut	Miss H. G. McCabe Industrial Relations Officer
United States Rubber Company * 1230 Avenue of the Americas New York 20, New York	Harry J. Ingram Assistant Manager of Personnel

* Only applicants from the area near the company's operations are considered for summer employment.

† In order to obtain clearance, early application is required.

The Teaching and Practice of Soil Mechanics—A Second Comparison

RALPH B. PECK

Professor of Foundation Engineering
University of Illinois

A little less than 20 years ago at an ASEE meeting in Ann Arbor I spoke briefly on the subject, "The Teaching and Practice of Soil Mechanics—A Critical Comparison." At that time I had recently completed a period of formal study in soil mechanics, was teaching the subject in the evening division of an educational institution, and was engaged in the construction of the initial system of the Chicago subways. My remarks were prompted by the observation that what I was teaching my students and what I needed to know in the practice of soil mechanics on a construction job were often quite different. In particular, I was struck with the importance of learning the pattern of behavior of soils by means of field observations, and the subordinate place that had to be given to the application of theory and the results of laboratory tests.

After two decades of continued teaching and practice in the application of soil mechanics, I have found it of interest to reexamine my thoughts on the relation between what we teach and what we need to know. This reexamination accounts for the title of this short talk.

I have come to believe that the application of soil mechanics in practice requires a thorough knowledge and background in three quite separate areas. The first of these is a knowledge and appreciation of the theoretical and experimental tools that are often regarded as soil mechanics proper. Although the instances may be few in which elaborate theoretical calculations are justified, or in which elaborate testing programs of soil samples may be useful, the insight and judgment arising from an intimate knowledge of these matters cannot be overemphasized. In spite of the fact that some of the more experienced practitioners of soil mechanics may rarely make a theoretical calculation, unconsciously they bring to focus on many a problem the fruit of years of theoretical studies and investigations that subsequently became an integral part of their engineering background.

In this day when the emphasis in engineering training has turned so strongly to the scientific side, there is little danger that this phase of soil mechanics will be underemphasized. On the contrary, the danger exists now, even more than it did two decades ago, that soil mechanics may be looked upon as an excuse for injecting into the students more mechanics, strength of materials, theories of failure, and fluid dynamics. If this could be done without slighting the other two basic aspects of soil mechanics, there could be little objection. Unfortunately, with the present trend many students are led to believe that theory and laboratory testing constitute the whole of soil mechanics.

A Foundation of Experience

The second foundation of soil mechanics is experience. The traditional knowledge of our predecessors, as well as a thorough knowledge of design and construction procedures and their consequences, are utterly indispensable for successful practice. To at least a limited extent, background in practice can be taught successfully at the undergraduate

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and graduate levels. The general trend in engineering education would suggest that the curriculum should not include subject matter of this type. Nevertheless, in my own opinion at least, it would be a serious mistake to leave it out of our teaching, or to permit the subject of soil mechanics to be taught by individuals who do not posses an adequate background of field experience.

At the present time there is a shortage of men well trained in soil mechanics. Recent graduates or men who have recently received higher degrees are put quickly into places of considerable responsibility in design or construction. They can and do make serious mistakes if their training has been lacking in the art of engineering. A man who has been trained only in theory and in laboratory testing may be incapable of recognizing the significant problems in the field, and even if he recognizes them, may have no idea of how to cope with them. If he cannot depend on a calculation or perform a laboratory test, he does not know how to proceed. Yet, there are a great many practical problems that can be solved in proper engineering fashion if the engineer is aware of appropriate techniques developed in practice.

Importance of Geology

The third fundamental aspect of soil mechanics, and the one that has increased in significance in my mind over the past 20 years, is geological. Except for those projects dealing with earth as a construction material, all problems in applied soil mechanics are concerned with the behavior of natural materials in place. The history of formation and the anatomy of these deposits are in the domain of geology. Indeed it may be said that in connection with earth tunnels, foundations for dams, correction of landslides, and a series of similar problems, engineering geology and applied soil mechanics are one and the same thing. Yet the teacher of soil mechanics all too rarely understands the fundamental significance of geology in his field.

Much has been written about and much lip service has been paid to the idea of the fundamental variability of natural soil deposits. Yet, the full impact of this variability is almost always lost on an individual whose training has been exclusively along the lines of mechanics, hydraulics, and strength of materials. At best such a man is likely to say that the variations in soil deposits must be recognized but that they can be treated statistically and, hence, mathematically. Unfortunately this is often not true because soil deposits are not built in random fashion but are the products of natural processes and have been endowed with a pattern arising from the laws of cause and effect. Hence, the variations can be treated intelligently only on the basis of the natural processes that created them. In short, they must be studied from a geological point of view.

My point is that the inherent variability of soil deposits is as fundamental a part of soil mechanics as is the existence of pore pressures. To study the latter and to ignore the former is unrealistic in the extreme. If engineering education tends today to emphasize fundamental knowledge, we should not be guilty of excluding from the category of fundamentals one whole aspect of soil mechanics.

As a matter of fact, soil mechanics has been one of the means for bringing geology and civil engineering closer together. Geology has been strongly influenced by the success of quantitative scientific methods that soil mechanics has brought to bear on geological problems; the new and growing field of rock mechanics might almost be described as the application of principles and procedures of soil mechanics to rock problems in geology. Much of this application has been made by geologists. Conversely, geological methods, when understood by the engineer, have proven highly productive. The engineer with his borings and soil tests must always interpolate or extrapolate in order to get suitable values for design or construction, but he does not always realize that every such process of interpolation or extrapolation is an exercise in geology. If he has the assistance of a competent geologist or if he is trained in geology himself and appreciates its significance, the engineer's inter-

polations will be reasonable and meaningful. If he does not have such assistance, the results may be ridiculous.

For example, in connection with a series of railroad cuts in the valley of one of our western rivers, test borings showed successive deposits of coarse gravel and varved silts. The gravels were sometimes above the silts, sometimes beneath. The elevations at which gravels or silts were encountered were not always consistent, even in borings close to each other. As more and more boring data were accumulated and were interpreted from a strictly engineering point of view, the results only became more complicated. A geological study, based on field reconnaissance alone, indicated the geologic history of the valley and the sequence in which the various materials had been laid down and cut away. Once the geological interpretation was available, supplemented by a few test borings in critical places, the interpretation of all the test borings became logical and for the first time a clear picture of anticipated conditions could be developed. Certainly in this instance a knowledge of the geological implications was as fundamental to the engineer's understanding as a knowledge of the fundamentals of theory of soil behavior.

Interdisciplinary Cooperation

It is not surprising that a most fruitful cooperation has developed at the University of Illinois between the Departments of Civil Engineering and Geology. The cooperation which had been growing for many years was heightened in 1955 by the appointment of a Professor of Civil Engineering and of Geology, who is a staff member in full standing in both departments and, as a matter of fact, in two different colleges. Much of the cooperation between the two departments is brought into focus by this man's activities, although the other members of both departments contribute to the coordinated effort. The final products of this cooperation consist of Ph.D.'s in geology with a strong minor in civil engineering, including strength of materials and soil mechanics. They also consist of Ph.D.'s in civil engineering with a strong minor in geology, including physical and historical geology, geomorphology and sedimentation. We consider these men among the most valuable of our products and their services have been in high demand.

From time to time I become aware of departments of civil engineering who wish to have no intercourse with departments of geology in the same institution, and even more often, strangely enough, departments of geology that wish not to cooperate with engineers. These attitudes are almost incomprehensible. Cooperation at our institution has been mutually beneficial to a high degree and is a goal toward which we have been working for many years. The more progress we make in this direction the more we come to realize the fundamental position of geology in applied soil mechanics.

In short, the fundamentals of applied soil mechanics, and the prerequisites for successful practice, are three in number. These three are a thorough grounding in the theories and concepts of the behavior of soil materials; a thorough knowledge of the accumulated experience of our contemporaries and predecessors in the field; and a working knowledge and appreciation of the aspects of geology related to soil materials. No one of these fundamental aspects can be eliminated from our training without serious damage.

ASEE ANNUAL MEETING, PURDUE, JUNE 20-24

All You Need is a Handbook

HAROLD R. BUHL

Associate Professor of Mechanical Engineering
Iowa State University, Ames, Iowa

> Colleges can highly serve us where they aim,
> not to drill, but to create. Emerson.

If you are completely satisfied with the quality and ability of our engineers, read no further. I have nothing to offer you. But if you believe that the quality can be improved, if you are constructively dissatisfied with the methods as they now exist, if you believe that the engineer is placing too much reliance on handbooks and cold formulas and is unable to solve total problems creatively—then here is an offering. This is a proposal to those who feel that the engineering schools can do more to educate men in solving problems from the very beginning to the very end, and in utilizing every possible means to come up with the best possible answer.

Some years ago a group was discussing the matter of requirements for engineering work. Someone made the remark, "All you need is a handbook." Here is a pointed and irritating comment for men who have invested at least four years in an engineering education. If the characterization is right, then it naturally follows that we could have saved four years. And yet, doesn't engineering often appear to be a matter of finding the proper formula or procedure in some handbook?

An effective device for solving problems is the technique of asking pertinent questions. It seems appropriate here to ask, "Why did you go to college?" Why should our qualified students go? What should they really accomplish during the four or more years in school? This is basic to all that follows. Can you really answer these questions?

Recommended by CYET

The Goal

I would propose here that the goal is to attain the *ability to solve problems*, especially those of a technical and engineering nature. If an engineer is able to solve engineering problems, his betterment and achievement will follow. These problems are usually new ones, not the old ones for which we have the answer. There are answers in the handbooks for the solved problems. It's the unsolved problems that give us the trouble. And there are all too few engineers who can handle them.

Then how do we best acquire this problem solving ability? In the past we have believed that this could be accomplished by the acquisition of a vast store of solutions to past problems. To this end the student was required to design a punch press, determine the efficiency of the laboratory steam engine, determine the torque curve for a gasoline or Diesel engine. And then we hoped that through habit transfer, the student would be able to solve different problems—not steam engines but gas turbines, not a straight-line mechanism but a servo-mechanism.

Education has in the past been concerned with old problems. However, the student never encounters these again. In the next encounter the situations have changed, the requirements are different, and the solution must be different. If he only knows the old solution, he is not able to reassemble the basic concepts into a new pattern. Engineering is not like a trade: sawing off a board shorter or longer, assembling pipes and valves in various orders. If it were that, the handbook would be sufficient and the formulas would be all we need.

In the past it was thought possible to expose the student to all the engineering knowledge available. He could analyze and design a steam engine, he could determine the velocities and accelerations of every mechanism, he would know all the short cuts and all the special formulas. The day he graduated, he would be skilled enough to design any device his employer wanted. But engineering got ahead of us. Each problem solved offered two new ones. Each theory developed suggested two new ones. And so, it was no longer possible to give every practical course required—not in four years, not in five, not even if we omitted all the humanities courses.

A Better Way

There must be a better way. If we can't give the student every solution, let's show the student how to solve problems, let's give him experience in solving new problems, and let's offer him enough of the fundamental concepts of engineering so that he has a start finding solutions. Let's give the student training and practice in finding problems, defining them, analyzing and breaking down information, in assembling the basic ideas into new patterns and testing the solution. The gathering of data is but one narrow aspect of the procedure.

If the goal then is one of learning to solve problems, only those factors essential to this goal need be considered as essential to engineering education. Special courses on "how to do it yourself" do not appear necessary. The fundamentals must be presented in such a way as to permit rearrangement and revision to adapt them to new problems. That is, we must give the student a collection of basic concepts, not just a collection of formulas.

Perhaps an understanding of the problem-solving process as here conceived will clear up the matter. It appears that there are several phases (not necessarily steps) in solving engineering problems. It must be pointed out that, as in all engineering, much remains to be learned and understood. This does not obviate the need for teaching what we so far know and understand (after all, we still teach convective heat transfer). The work of Wallas [1] was an early and very successful attempt to understand how we approach problems. This work was substantiated by Hadamard [2] and others. Men of scientific history, such as Poincaré,[3] seem to justify the results. It must be pointed out that the order does not necessarily imply a 1, 2, 3, 4 sequence. There appears to be much repeating, backtracking, and middle-starting. These phases are as follows:

Realization, definition—It seems obvious that we must have a problem but it is disturbing to see the number of engineers who can relax unconcernedly beside a problem. It often occurs that even very capable students ask for thesis subjects or for problems to solve. It is also necessary to be determined to do something about the disturbing situation. To define the problem we must be able to sift the causes from the effects, and to determine basically what is desired.

Preparation—It is necessary to gather material from which solutions can be created. This information consists of past experiences and solutions, formulas, engineering concepts, opinions, and others. This must be followed by a breaking down into basic ideas: *analysis.* The basic ideas must be studied to determine cause-and-effects, common factors, patterns, inconsistencies and the like. The basic ideas must then be put back together in another form: *synthesis.* This is done by performing various operations such as reversals, multiplication, omissions, additions and the like. It is this phase that particularly requires every means in order to succeed: logic, intuition, guess, trial and error and many others. It is here that we need considerably more understanding in regard to its operations, conditions conducive and detrimental to its functioning. The solutions usually appear in their entirety and void of details. This requires filling in of the details and verification of the solu-

[1] Wallas, G., *The Art of Thought,* Harcourt, Brace, 1926.

[2] Hadamard, J., *The Psychology of Invention in the Mathematical Field,* Princeton University Press, Princeton, N. J., 1945.

[3] Poincaré, H., *Mathematical Creation,* translated by G. Halsted, The Foundation of Science Press, 1913.

tion. It is here that experiment, testing, and checking enter the picture.

This is the scheme into which engineering teaching must fit. All we do must be compatible with the method of solving problems. This is the common factor in solving all engineering problems, a method itself. To this end our procedures must be adopted.

How does all this affect teaching? Let's look at this stepwise according to the above enumerated phases of problem solving. To assist the student to realize and define problems, the lecture material must be presented in such a way that it attains its proper perspective: not as an end in itself but only as a start to solving problems. The answers to many present day problems are not satisfactory and better ones are desired. In the solutions, many assumptions were required and it is necessary from time to time to review the validity of these limitations. The student should learn that problems have more than one answer depending upon the assumptions made. He should understand that various problems in different fields may be solved by similar methods and have similar solutions.

In order that an individual be able to see problems and to define them he must develop certain qualities. These qualities are a sensitivity to problems and a constructive dissatisfaction with life coupled with a determination to do something. He must lack the gullibility which makes certain standard answers "obvious." He must develop a positive attitude that improvements can be made on everything. He must be flexible, able to change his thinking and able to make new combinations never before conceived.

We can develop these qualities in engineering education by many means if the way in which problems are solved is understood. This may be done by placing the emphasis on the method in preference to the answer. This is not to propose that an answer is unimportant, but that it must take its relative place. Evaluation is but one phase of the problem and the method must come first. Original thought must be encouraged and rewarded. In presenting formulas, the method and assumptions leading up to the formula must be emphasized in preference to the formula itself (it is here that the handbook fails and it is for this reason that we can't be handbook engineers).

Acquiring these qualities means that habits must be changed. These habits resist change and can be revised only by personal effort. The student should solve his own problems with guidance. He should not be supplied with ready-made formulas and answers. By assigning problems at the end of a chapter just studied, the student is supplied with the method of solution. His only real problem is adjusting the conditons slightly to get the answer already given. The problem becomes one of manipulating a formula to get "the answer," not one of acquiring basic knowledge.

The student should be given an understanding of the reasons why he may fail to get new ideas. Many "blocks" operate to stifle our ability to make unusual mental combinations. These may be emotional, cultural or perceptual. We fail to see all the implications of a problem because of the way we see things. We miss a solution because of the way we think things should be done. We miss a possible application because of what we think things should be used for. These blocks are the result of habits formed through all of the student's early life: home, grade school, high school, religious affairs, his social life. These habits can be changed but training and practice are required.

The phase of preparation required careful consideration. We have thus far been fairly successful in presenting facts but we have stopped too soon. Knowledge is basic to solving problems and without it nothing could be accomplished. But this information must be analyzed—must be reduced to basic ideas so that it can be compared, contrasted, studied. After this is done, and only then, can it be put into new combinations. The formulas and course material must therefore be presented in such a way that it can be later analyzed.

It is not sufficient to present a theory followed by sample problems and this followed by home problems which differ from the samples only in the values of the numbers used. This system relies on the

hope that by habit transfer, the student will be able to solve the new problem when it comes. This does not appear to be borne out, judging from the abilities of many graduates. The student must break down the course material into fundamental concepts. He must learn and experience manipulation of these concepts. He must ask such questions as: "What happens if I apply limits like zero and infinity to any quantity? What happens if I reverse a sequence? What would happen if I did this? What would happen if I added a factor or omitted a consideration? How does this fit in with other concepts in the same field or other fields?"

Proper education in preparing to solve problems consists in acquiring a repertoire of basic concepts and ideas. The achievement of solving ability by the experience of "practical" courses and experience in "typical" problems does not appear to be effective or practical. Facts and ideas have no significance in themselves, but must be related to each other. The testing of the student's ability to memorize and to mechanically use formulas bears little relationship to his ability to solve practical problems in the same field.

Synthesis

That phase of problem-solution called *synthesis* is interesting but little understood. Its accomplishment is difficult and the development of this ability has been largely avoided in education. It is known that the proper atmosphere (permissive) contributes greatly to the development of this talent. The success of certain educational institutions in producing scholars and creative graduates may be largely attributable to this factor. This atmosphere consists in those elements which overcome the student's fear of failure and his reluctance to change. The student must be given the opportunity to make mistakes, to try different methods even if they fail. He must be free of evaluation during the actual learning process so that he is encouraged to attempt new things. Judgment of his ability should be reserved for such a time when he has had adequate opportunity to master the concepts.

The student will acquire an ability to synthesize new solutions if he is encouraged to try all methods, even those based on trial-and-error, hunches and guesses. He, above all, needs specific training and experience in manipulating ideas and in asking leading questions.

Conclusions

We may resolve all this into three conclusions:

1. Engineering education requires specific training in all phases of problem solving. This would include instruction in how to solve complete problems, the creative aspects of solution, and what questions to ask oneself in solving. Training should be given to remove any blocks to thinking and to change the habits to those more conducive to successful problem solution. Courses in the fundamentals of engineering should be designed to supplement the phases of problem solving and material should be presented in such a manner as to permit its utilization in new problems. The labs should be used as means for training in the gathering of data and in the solution of actual and practical problems (new ones if possible).

2. The student should be enveloped with a permissive atmosphere. He should be encouraged to solve problems in many ways. He should be free from continual evaluation while learning so that he will be free to try new methods. We should encourage a system of intensive learning of basic concepts followed by leisurely application to real problems.

3. The engineering curricula should be restudied to determine if all the courses offered are truly fundamental in nature. The material should be reviewed to determine whether it is conducive to analytic and synthetic procedures. Our practical courses must serve a real purpose and our labs must do their fair share.

Engineering education can do a better job. A better job is required. The engineer requires more than an ability to use a handbook. We can have superior engineers *if* colleges will "aim, not to drill, but to create."

A Modern Approach to Teaching Manufacturing Processes

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As funds of scientific knowledge accumulate at accelerating speeds, it is natural that pressures should be applied to reduce or eliminate time consuming laboratories to make room for the teaching of subject matter not even conceived of a short time ago. The result has been a decrease in laboratory type work in manufacturing processes, to as low as zero in some curricula, even for students almost certain to be placed in manufacturing positions.

The personnel directly concerned with this area at The Ohio State University feel that the challenge of time savings can best be accomplished by combining the introductory courses, in our case three in number, into a new course of completely new format. Time savings can be produced by elimination of details and duplication and reduction of attention to skills. At the same time, greater stress on the scientific and economic aspects of manufacturing processes will improve the educational value of the course for engineering students. A very distinct possibility exists for providing better education in less time than with the traditional courses.

At Ohio State, it was felt that complete elimination of the laboratory would be a serious mistake. The student needs a physical concept to which he can relate the theories and discussions of operations. Relatively few students have had any contact with manufacturing equipment or processes. In addition, there is nothing like pitching in to do work personally, dirty hands and all, to develop a feeling of confidence so necessary to straight thinking.

In recent years, until the 1957–58 school year, introductory material in the manufacturing processes area was covered at The Ohio State University primarily by three lecture-laboratory courses, each of which made use of six student contact hours per week divided into approximately two hours' lecture and four hours' laboratory work. In all courses the emphasis was on theory and the laboratories were used for demonstration of principles rather than for development of skill of operation. Some development of skill is valuable to the future practicing engineer as an aid for recognizing and understanding operation problems. At this level, however, the principal interest is in teaching that minimum skill necessary to prevent danger to the student and damage to the equipment.

The three laboratory areas consist of a foundry, a machine tool laboratory, both administered by the Department of Industrial Engineering, and a welding laboratory controlled by the Department of Welding Engineering, all housed in the same building.

The foundry has a mechanical sand handling and conditioning system which carries prepared sand to molding machine stations. Molds for iron castings are moved on a roller conveyor to the pouring station at the cupola and through a cooling cycle to the shakeout. The facilities also include molding benches for non-ferrous work, gas fired furnaces for non-ferrous metals, a core room with core furnace, casting cleaning equipment and sand testing equipment.

In the machine tool laboratory, the majority of machines are of standard job shop types, but sufficient mass production type equipment is available to permit demonstration of mass production principles. The shop is fitted with a sufficient number of engine lathes so that

each student can be assigned to this type of machine as a "home base."

The welding laboratory is divided into three main parts. A heat treating area contains enough furnaces to permit students to work in small groups with problems of heat treating and metallurgy. Various test equipment is associated with the area. Individual stations are available along a manifold system for gas welding and individual booths are furnished each student for electric arc work. Representative equipment for practically every kind of welding is also available for welding demonstrations.

Objectives

Three separate courses of this kind taught by specialists in each field are naturally in competition with each other. More repetition develops, particularly in relation to heat treating and other metallurgical aspects, than is necessary for good tie-ins, and because of the introductory nature of the courses, apparent inconsistencies are a detriment to good teaching. For several years the staff of these related areas have consulted and worked together to develop a course with the objectives of:

1. Reducing the amount of time spent by the student in the area of manufacturing processes without sacrifice to his ability to make use of knowledge in this field.

2. Applying' broad principles across the entire field of manufacturing processes. Establishing a basic understanding of maufacturing in general on which to build other studies such as product design, machine design, plant design, time and methods, process control, etc.

3. Eliminating the inconsistencies, biases, and prejudices existing between the various parts of the field.

4. Providing an integrated picture of manufacturing to the student so that his main interest may be in the results at the end product rather than in the details of the process steps. The integration should relate theory to practice in operation and show the interrelations that exist between the processes.

It should be pointed out that the combining of three such courses into a satisfactory single course is not a simple task. Breaking down the prejudices of a group of specialists and the development of necessary open minded attitudes of the teaching personnel require discussion over lengthy periods of time. In our particular case, an additional problem existed because one subject area and its associated laboratory was governed by a different department from the other two. Cooperation of Professor R. B. McCauley, Chairman of the Department of Welding Engineering, has permitted the design of a combined course administered by the Department of Industrial Engineering that seems, after two year's test, to meet the objectives outlined above. Although it may not be unique, the course discussed here seems to be different from that used by most engineering schools.

"Industrial Engineering 519. Manufacturing Processes. Five credit hours. One quarter. Autumn, Winter, and Spring. Four hours lecture and six hours laboratory each week. Industrial Engineering, Mechanical Engineering and Welding Engineering, third year. Agricultural Engineering, third year. Prerequisite, third year standing in the College of Engineering or written permission of the chairman of the Department of Industrial Engineering.

"Fundamentals and interrelationships of the principal manufacturing processes. Laboratory work in the areas of foundry, machine tools, heat treating and welding. Safety glasses required in laboratory."

The above catalog description roughly describes the new course, which is based on ten weeks of ten contact hours each. Two-hour periods, with a short break in the middle, on Tuesdays and Thursdays are used for classroom discussion based on a schedule distributed at the beginning of the course.

Course Organization

For purposes of efficient use of laboratory facilities three sections of twenty students each are scheduled for the same hours. On the first day all meet together, but succeeding classes are held in sep-

arate classrooms with an instructor assigned to each. The sections are rotated each day in the laboratories, resulting in one two-hour period in each laboratory each week. After the first meeting the instructor assigned to any given section stays with that group for all classroom work and through all the laboratories. Although this might appear to be inefficient use of specialists in the various fields, experience indicates that this is the most satisfactory way to obtain suitable course integration. This integration is the most important benefit to be derived from a combined course.

The classroom subject matter is distributed over the twenty discussion periods in the following manner:

I. Registration and Introduction

All students (three sections) meet together. One of the three instructors conducts class. Group divided for subsequent meetings. Discussion—course organization, initial work, and assignments. Most common manufacturing concepts. Definition of common terms with material properties.

II. Metallic Materials

Metallic materials in terms of atomic structure. Alloy systems and the iron carbon diagram.

III. Materials and Properties

Theory of heat treating together with composition and characteristics of various steels.

IV. Fundamentals of Machining

Machinability including chip formation, tools shapes and angles, tool materials, and coolants.

V. Gas Welding and Brazing

Description of welding bonds with detailed study of fusion bonding. Gas welding and cutting equipment. Brazing and soldering processes.

VI. Fundamentals of Green Sand Molding

Molding equipment and terminology. Foundry sand. Cores and core making. Pattern types and molding processes.

VII. Solidification of Metals

Metal contraction and grain formation in castings. Casting processes and characteristics of common casting metals.

VIII. Cast Irons and Non-ferrous Materials

The iron-carbon diagram in the cast iron range. Effects of carbon, silicon, and cooling rates. Types of cast irons. Aluminum and copper base cast alloys.

IX. Welding Metallurgy

Arc welding nomenclature. Heating and cooling effects on metals. Residual stresses and their relief. Distortion of weldments.

X. Arc Welding

Electric arc theory. Electrodes and coatings. Arc welding equipment and its characteristics.

XI. Welding Design

Design considerations for welded joints. Types of joints and relation to weld types. Weld symbols. The welding symbol. Design for stress and deflection.

XII. Flat Surface Machining

Principal machines and processes for machining simple combinations of flat surfaces. Shaping, planing, surface broaching, sawing and filing, milling, and surface grinding.

XIII. Machining of Circular Cylinders and Cones

Principal machines and processes for machining circular cylinders. Turning, boring, milling, cylindrical grinding, drilling and reaming.

XIV. Non-circular Machining

Principal machines and processes for machining partial and non-circular cylinders and warped surfaces. Broaching, band sawing, gear hobbing, gear shaping, duplicating and threading.

XV. Production concepts

High production, labor reduction, product redesign, machine modification.

XVI. Plastic Flow Theory

Elastic and plastic flow. Residual stresses and strain hardening. Recrystallization.

XVII. Cold Forming

Characteristics and requirements. Squeezing, bending, shearing, drawing.

XVIII. Hot Working

Characteristics and theory. Rolling, forging, tube making, extrusion, and powder metallurgy.

XIX. Surface Treatments

Cleaning, surface hardening, painting, plating, anodizing, and metallizing.

XX. Integration

Systematic procedure for development of a product. Illustration of process choice based on end product.

It will be immediately noticed that a lack of continuity exists for some of the subject matter. The purpose of this order is to permit a discussion of the basic principles for each laboratory area as early in the course as possible. The student can thus recognize the application of theory and derive more benefit from the laboratory operations. The spottiness of the presentation introduces no great problem for the student providing he understands the reason for such an arrangement.

The economics of manufacturing operations are stressed throughout the course. Emphasis is placed on the production of a satisfactory end product by the use of the processes that are the most economical for the particular situation. Consideration of overall costs introduces thoughts of every phase of manufacturing. The difference in process choice dependent on quality, quantity, and available facilities is strongly brought out with this emphasis.

Although in most cases he has additional technical help, the classroom instructor also conducts all the laboratory sessions for the same group of students. He, therefore, is fully familiar with the problems and experiences of his own group. In addition, since the laboratory work rotates each week through all the areas, he must become completely familiar with all the laboratory operations. This in itself is an extremely valuable aid to the elimination of bias and integration of subject material.

Each of the laboratories is operated in a slightly different way. The foundry is primarily a production shop supplying castings to the machine tool area for further work. Weekly rotation through production jobs and demonstration of low rate jobs add to the students' experience. Non-ferrous materials are poured almost every period and cast iron is poured by each section at least once during the course. The machine tool laboratory makes use of exercises on items which after completion can be assembled into useful products. Some of the parts are made on job-shop type machines while others are produced with production tooling and equipment. The heat treating and welding laboratory is limited to the use of exercises on parts that are discarded after completion. Part of the reason for this is the difficulty of planning useful products that do not entail a large per cent of waste time as far as educational aims are concerned. Although student interest is usually more easily generated by making useful products, there is broadening value to the student in the varied operation of the three laboratories. In addition, it is almost impossible to set up many useful products that suitably demonstrate the different principles under consideration.

Grouping this subject material brings together a great mass of terminology and detailed information that is likely to be confusing when offered to a student in a single course. In order to maintain proper student attitudes it is essential that all unimportant detail be eliminated from the course and that the students' attention be focused on the overall purpose of the course. That purpose is the development of the ability to trace an economical path through the various manufacturing processes to an *end product*.

Covering this much material calls for maximum efficiency in the use of time. Properly prepared visual aids can aid immensely in conserving time and improving student understanding. Whenever practical, the material offered in the classroom is illustrated by colored slides. The lights for general illumination are shielded from the screen so they may be left on at all times. Approximately seven hundred slides have been prepared for this course to illustrate all the subject material. These are shown through a remote controlled projector so the instructor may always keep a picture on the screen related to the subject under discussion. All the slides are cataloged and indexed to the lecture outline

used by the instructor. A large amount of thought and time has, of course, gone into the design and preparation of these slides, which include pictures of equipment, curves, charts, sample problems, and almost anything that can be shown in pictorial form.

Good Results

Experience for the first two years with the course briefly outlined here indicates good results. Students seem to acquire a better understanding of manufacturing as a whole and are better able to relate the various processes to theory. The instructors in the course are forced to broaden the scope of their activities, thereby improving their teaching ability in all fields. Although of no interest from the academic point of view, it is of high interest to administrative personnel that under this system approximately three times as many students can be processed as could be under the old system of separate courses, without increase of the physical facilities.

We feel that many schools are likely to arrive at a solution similar to that discussed here for the problem of finding time for the increasing curriculum material.

NSF SURVEY OF SOVIET SCIENTIFIC LITERATURE

A detailed survey of the present effort to supply United States scientists with Russian scientific literature, released by the National Science Foundation, lists 76 Soviet journals now available in English.

The survey reports on the sources of Soviet scientific literature, availability of such literature in the United States, and the current translation programs of professional and academic groups and government agencies. Current methods of providing comprehensive coverage of untranslated Russian material are also analyzed. Revised and expanded from an earlier edition, the survey was prepared by the Foundation's Office of Science Information Service.

According to the survey, *Providing U. S. Scientists with Soviet Scientific Information,* 2,026 scientific journals and serials are being published in the USSR. Since 1956, Soviet scientific materials have become increasingly available in the United States. They are listed in the *Monthly Index of Russian Accessions,* published by the Library of Congress and available from the Superintendent of Documents of the Government Printing Office. Many, although not all, publications of individual institutions in the Soviet Union are available on an exchange basis, the survey states. The Processing Department of the Library of Congress maintains a list of Soviet institutions with which the library has exchange relations.

Translations of Soviet scientific journals are made available by three methods. 1. A large number are made under grants by Federal agencies to non-profit scientific societies or research institutions. Most National Science Foundation grants are of this type. 2. Others are produced under Government contract with translating agencies. 3. A number are translated privately without governmental subsidy.

The two main translation depositories in the United States are listed as the Special Libraries Association Translation Center, located at the John Crerar Library in Chicago, collecting from non-Government sources; and the Office of Technical Services, Technical Information Division, Department of Commerce, collecting from Federal agencies and foreign sources.

All translations are listed, with abstracts, in *Technical Translations,* published bimonthly since January 1959 by the Department of Commerce. Translations of Russian scientific books are made by commercial publishers, and by Government agencies through contract, grants, or directly by the agencies themselves.

Drawing by Remote Control

(Correspondence Teaching)

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I would first like to quote from a statement by Dean J. R. Morton, of the University of Alabama, president of National University Extension Association: "Correspondence Study was one of the first extension services to be studied carefully and used widely. Almost a half century ago, it was established that learning by mail is an effective means of education, and it was about that time that many first-class educational institutions established the machinery for learning in this way. I do not believe we have any realization yet of the limits of educational service which can be reached by this means."

It would seem at first thought that a correspondence drawing course, mechanical or otherwise, would be quite impractical or difficult to accomplish. Drawing, sometimes classified as "laboratory," requires a work desk and certain tools and apparatus. In that sense it falls into a "laboratory" procedure. To attempt it in correspondence form could be considered ill-advised or of limited usefulness.

However, in any resident drawing course, the student generally is required to provide his own equipment, that is, the instruments, scale, triangles, etc., even a board and T-square. The school in which he works on the course provides merely a place to assemble, with lights, desk, and storage space. If, for correspondence instruction, the student obtains the same tools and accessories, and is presumed to have access to a lighted desk or table, he can proceed with training in drawing with very nearly the same "laboratory" facilities that he would have in a resident course.

Of greater importance, naturally, is the problem of giving the correspondence student the equivalent of the lecture, the discussion, and the advice and coaching that an instructor gives to a class in the drawing room. It is my belief, however, that we as drawing instructors somewhat over-rate ourselves on this phase of the learning process. We like too well to hear ourselves talk and to display what we think we know on the subject. Nine-tenths of what the class instructor delivers to the students is probably available in the textbook, and in better form and better illustrated. He repeats it largely for reasons of giving emphasis, as a substitute for the text if it appears the students did not do any text studying, and to expedite and hurry the students into prompt execution of a drawing assignment. Time allotted to drawing periods is on the meager side, and the class instructor attempts by verbal introduction to get the most of apparent accomplishment completed in the limited time.

For correspondence training most of the foregoing is either not relevant or can be provided in references and notes that accompany the assignment outline. Text study assingments specifically made relative to each phase of drawing must be assumed to be digested by the distant student. He has no other source beside him for the information; he can not raise his hand and ask an instructor to repeat the words. He just expects the desired material is in the text references and illustrations, and knows he must take the time to digest it.

Presented at the 67th Annual Meeting of ASEE in Pittsburgh, June, 1959. Recommended by the Engineering Graphics Division.

The function of a class instructor in hurrying students through an assignment in a limited time period is likewise not too important or relevant in correspondence work. While some attempt in the outline of assignments should be made to keep the total time requirement within reasonable limits, there is no requirement that any assignment has to be started and hurried through and finished in exactly a two or a three-hour period. The assignment may have a suggested time allowance indicated, but the correspondence student can proceed with the drawing and sandwich it with back references to the text in whatever time arrangement seems to his best convenience.

A correspondence course must provide a substitute for an instructor in certain ways. The assignment outline must be very specific in stating requirements both regarding text study and solving drawing exercises. The course must be divided into moderate length "units," so that an excessive amount of theory and text study is not assigned at one time.

A unit must give the subject heading for that part of the work, and indicate the pages or chapter of text assignment. The subject must be introduced, and its importance or relationship to drafting procedure pointed out. The drawing exercises must be carefully selected to exemplify the subject matter treated. Instructions pertaining to each problem must specify exactly what is wanted as a solution, must include references to particular text paragraphs or figures which bear on the desired solution, and give any other information needed for straightforward completion of the drawing. In these respects, the written part of the assignment sheets does substitute for the voice of the classroom instructor, but often must go even further. The writer of the assignments must be experienced in knowing the details of every phase of the work. He must anticipate questions that might be voiced by students in each problem, and know how to answer them in advance on the assignment sheets or give specific text references to provide an answer. The student in correspondence should not be left up in the air with a question that blocks him from further execution of the drawing.

Lettering practice assignments must also be specified in each unit. The student should have perfect or near-perfect copy models for this. Several lettering practice books are available in the market, having excellent copy models and instructions for doing the exercises.

Procedure

When the student completes each unit assignment he sends it to the Correspondence Study Office for grading and recording. An instructor marks all corrections and omissions, being careful to make such notations explicit. It is not sufficient to do as might be done in a classroom, that is, mark a red-pencil circle around something questioned. Unless the correction is obvious beyond any doubt, the reviewer must write out exactly what is wrong or omitted, or give a specific reference to provide the information. Most sheets should also have a "grade" indicated. The student has a right to know how well his work has approached the standard expected. Grades are usually well understood if on the 100% basis,—or they may be in terms of A, B, C, D, E.

The student's work should be returned to him as promptly as possible. In the meantime, he can proceed with the assignment of the next unit. His first papers, with corrections and suggestions, will generally get back to him before he is ready to send in the next unit.

Periodic tests and final examinations are a part of the courses, and these are given under supervision. The supervisor, usually a local school teacher, agrees to administer the tests, and to see that they are executed properly.

Experience

At the University of Michigan, our Correspondence Study Department currently offers 60 college level courses by mail, most of them with college credit. An equal number of high school subjects are also offered, intended for individuals who wish to gain high school credits or otherwise prepare for further work. Five

Engineering Drawing courses are included. Two of these, Elementary Mechanical Drawing and Blueprint Reading, are at the high school level and give no college credit. The other three courses are the same as required of University students in residence, and give the same credit toward an Engineering degree. These are Beginning Engineering Drawing, Descriptive Geometry, and Advanced Engineering Drawing.

What quality of work is usually done? In terms of the drawings or problem sheets submitted, the average equals that of college resident students. Test results are likewise comparable. While not discounting the value of an experienced engineer and drawing instructor to students in a class, the absence of such does not seem to be a major handicap to correspondence students. As compensating features, the latter are perhaps a little older, more mature (average age of the enrollees the past seven years was 26), they are generally working in related activities and handle shop or construction drawings, and might be more strongly motivated to apply themselves to the maximum in learning the material they have paid for.

Attempt is made to grade all exercises and tests to the same standard as in resident classes. Of course it may be asked, "How do you know the correspondent student does not get improper help on the assignments?" The answer is, "We don't know." But we feel sure there is no more lack of individual work there than in our campus classes, if as much. Campus students have all kinds of opportunity to confer on their homework; even in the classroom much guidance comes from both the instructor and the other students. Files of previous years' drawings are at hand in most of the dormitories and fraternities. Some instructors have even displayed complete solutions in front of students, and inferred they should merely copy the same. (Incidentally, I contend there is no more boring or depressing a drawing assignment than to just "copy." The student loses all the satisfaction and thrill of *creating* something. Outside perhaps of a little "technique," he develops in himself virtually no new knowledge or ability. There is the same distinction as between a mason on the one hand to be merely "laying a brick," and on the other hand to be "building a cathedral.")

Correspondence students usually are located in widely scattered communities, are pursuing the drawing work individually, and except perhaps for suggestions from associates are not in contact with work previously executed or known. Altogether, we believe the assignments are done more individually and independently by correspondence than in resident classes.

History

Correspondence courses were first offered by the University of Michigan about 1935. Some inquires had been received from potential enrollees concerning mechanical drawing courses. The Engineering Drawing Department was approached as to the feasibility of doing drawing by remote control, and with some misgivings we offered to write up and administer two elementary courses.

The first specification and assignments were sent out with some doubt. It was virgin territory for us. Were the instructions explicit enough? Could an enrollee's interest and application be developed and maintained? Could he proceed without an instructor to the study and to the problem exercises and complete them creditably? Would he be stopped in his procedure by all sorts of questions and doubts? Would he give up or drag out interminably in finishing the course?

Happily, most of the answers were on the favorable side. On on average, the correspondent students took longer than four months to complete a semester's course, and naturally a disappointing percentage never did get through. The "drop-outs" in any extension course, correspondence or class, are always greater than in a regular campus class. However, results were judged worthwhile, and after the two elementary drawing courses seemed to meet a need, two others were added. These were a non-

credit course in Elementary Blueprint Reading and a credit course in Advanced Engineering Drawing. For enrollment in the latter course, Descriptive Geometry was supposed to be a prerequisite, but a distant student could not very often meet this unless a local Junior College offered the subject. For a number of students prior to 1956, the Descriptive Geometry requirement was waived if their elementary Engineering Drawing was up to B-grade. In 1956, correspondence specifications were written for Descriptive Geometry, and scattered enrollments are currently made in it. It is too early yet to reach any conclusion as to how successful this subject is in correspondence form. Certainly in the classroom there is more need for an instructor to discuss and to quiz than in a straight drawing course. The Descriptive Geometry correspondence guide or specifications must substitute for the instructor as far as possible, more than in the other courses. Even with the most extensive instructions and guidance that can reasonably be given, with all text references and construction cues included in very ample proportions, it is conceded that a successful correspondence student in Descriptive Geometry must be somewhat keener, better prepared, and more industrious and aggressive than the usual college freshman.

A 7-Year Survey

Several years ago a study was made of 177 cases of correspondence students who enrolled in drawing courses over a 7-year period, 1942–1949. It involved elements of grade earned, time of completion, and proportion of "drop-outs."

It is seen that a majority of those who finished the courses required up to a year to do so. The grades, A, B, C, D, seemed to have no correlation to the time taken. The average is about the same whether completed in the minimum time classification or in a period of two or more years.

What was a bit startling and disappointing was the large percentage who en-

TABLE 1

A 7-YEAR STUDY OF ENROLLMENT IN CORRESPONDENCE DRAWING COURSES

University of Michigan

July 1, 1942 to June 30, 1949

	Elem. Mech. Draw.	Begin. Eng. Draw.	Descr. Geom.*	Adv. Eng. Draw.	Blue-print Read.	Total	Per Cent
University credit, hrs.	—	3	3	2	—		
No. enrolled (7-yr. period)	45	93	*	22	17	177	100
Course completed, and grade:							
Within 16 weeks	—	1-A 1-B	—	—	1-B	3	2
Within 6 months	1-C	2-B	—	1-B	1-B	5	3
Within 1 year	1-B	5-B 2-C	—	1-A 6-B 1-C 1-D	1-A 1-C	19	11
Within 2 years	—	1-A 4-B 1-D	—	1-B	1-A	8	4
Within 2 to 7 years	—	4-B	—	—	—	4	2
Dropped out:							
Before 25% completion	37	40	—	8	11	96	54
Between 25–50% completion	4	21	—	1	—	26	15
Between 50–75% completion	2	6	—	1	1	10	6
After over 75% completed	—	5	—	1	—	6	3

* Descr. Geom. not offered until 1956.

rolled and started the courses, and then dropped the work before completion. This averages over 75%. The largest proportion of the drops, more than half the total enrollment, occurred with less than one-fourth of the course completed. Various reasons could be conceived for this large percentage. The instructional guide was inadequate, the subject matter not interesting, the work assignments too difficult or disappointing, plus many factors in a student's home or employment circumstances that might change and affect his study.

Some direct personal expressions were desired from non-service enrollees in particular as to their experience with correspondence drawing. For those who dropped out, it was hoped to find out what was the trouble. For those who completed, some expression was desired as to any difficulties, as well as whether expectations were realized on the value of the work. So an inquiry was mailed to 145 of the 177 who enrolled during the 7-year period. The 32 not canvassed had original overseas addresses, port-of-embarkation, prison addresses, or the like, which were assumed no longer in effect. Out of 145 sent, 21 envelopes were returned as "not known" or "moved, no address." Forty-eight actual replies came back, leaving 76 who apparently received the questionnaire but did not bother to reply. Half of those who finished their course replied, but only 20% replied who did not finish.

Forty-eight out of 177 is not a very large proportion on which to base conclusions, but still some indications therefrom were significant. The tabulation for these 48 is divided between (1) those who completely finished the correspondence course, and (2) those who did not finish.

Both groups indicated largely that the courses met their expectations, even if a fair percentage suggested points of improvement. The latter were miscellaneous suggestions of no common trend, but they have all been carefully considered and some of them since effected.

While virtually all of both groups said the courses were adequately specified, nevertheless many felt that the absence of an instructor in person was a handicap. Perhaps these two conclusions are partly contradictory. If a correspondence course is adequately specified and detailed and explained as an instructor would do in a class, his absence ought not be too serious. Perhaps he was missed for his sociability or for his jokes, or maybe because of a classroom speed-up influence. A majority, more pronounced in the group who finished, reported definite relation and value of the drawing training to their current or contemplated employement.

A hoped-for element in the survey was an answer to why such a big percentage (about 75%) of enrollees never completed the work of a course, and whether something could be done about it. Well, the 30 answers that came in were only a small proportion of the 138 who

TABLE 2

	Yes	No
Students who finished course (18):		
Value in present or contemplated employment?	13	2
Adequately specified?	14	4
Absence of instructor a handicap?	5	12
Meet expectations?	14	2
Course could be improved?	7	3*
Students who did not finish (30):		
Value in present or contemplated employment?	14	10
Adequately specified?	23	1
Absence of instructor a handicap?	14	15
Meet expectations?	21	3
Course could be improved?	6	9*

* Additional negative answers might logically be construed from the 23 replies which left this question blank.

TABLE 3

Reasons for dropping:

1. Not enough free time	6
2. Illness	5
3. Change of employment or school	5
4. "Expect to still finish"	4
5. Entered military service	3
6. Disappointed in course	2
7. Difficulty	1
8. No credit wanted	1
9. Domestic problems	1
10. Press of other responsibilities	1
11. Did not apply oneself	1

dropped out of work, and even the 30 were not very helpful.

The principal reason for not finishing seemed to be an idea of "not having enough time" to do the work. However, the press of time would logically be due to some other factor. Illness and change in employment or school attended are also given in a goodly percentage of cases. Out of the 11 classifications of reasons for dropping, No. 6 and No. 7 would seem to be the only two causes that would stand any chance of being remedied from the administration end. To reduce the likelihood of an enrollee being "disappointed" in the offering or of having it "too difficult," two suggestions might be in order. The prospectus or catalog listing of a course can be more complete and detailed with respect to nature of work, course content, materials involved, results expected, and time required. Also, the introduction and instructions in the course specifications for each phase of work can possibly be made more interesting and appealing, as well as carefully detailed with respect to each assignment and the procedure involved in problem solutions. Possibly the applicants should be more carefully screened in the first place. Corrected and marked exercises returned to the student must likewise be very explicit as to nature of mistakes and how to correct them.

Our correspondence courses are frequently rewritten, either for a new edition of a textbook or for a new series of exercises and problems. We have attempted each time to augment the previous writing by more informative and explicit instructions. From experience, we endeavor to anticipate "stumbling blocks" and reduce them to minor obstacles. Care must be taken, however, not to do all the student's thinking for him nor to take away his own development of a solution.

A Second 7-Year Survey

To see if our more recent offerings involved a bigger per cent of completion than in the immediate postwar years, a

TABLE 4

A SECOND 7-YEAR STUDY OF ENROLLMENT IN CORRESPONDENCE DRAWING COURSES

University of Michigan

July 1, 1949 to June 30, 1956

	Elem. Mech. Draw.	Begin. Eng. Draw.	Descr. Geom.*	Adv. Eng. Draw.	Blue-print Read.	Total	Per Cent
University credit, sem. hrs.	—	3	3	2	—		
No. enrolled (7-yr. period)	84	67	3*	36	35	225	100
Course completed, with grade:							
Within 16 weeks	—	1-A	—	3-A 1-B 1-D	3-A 1-B	10	4
Within 4 to 6 months	1-A 1-B 2-C	3-A 1-B	—	2-B 1-C	1-A 1-B	13	6
Within 6 mo. to 1 year	8-B 3-C	1-A 4-B 2-C	—	2-B 2-C	2-A 3-B	27	12
Within 1 year to 2 years	2-C 1-D	1-A 1-B	—	1-A 2-B	—	8	4
Within more than 2 years	1-B	1-A	—	1-B	—	3	1
Dropped out:							
Before 25% completion	28	28	2	15	16	89	40
Between 25–50% completion	12	9	—	3	5	29	13
Between 50–75% completion	21	10	—	2	1	34	15
After over 75% completion	4	5	1	—	2	12	5

* Descr. Geometry not offered until 1956.

second 7-year survey was made, for 1949–1956. The individuals were not given a questionnaire, but we compared final results.

For one thing, this 7-year enrollment totalled 225 students, an increase of 27% over the preceding 7-year period. More significant, however, is that 27% of the enrollment completed the courses, compared to 22% of the previous period. Those who dropped out within the first quarter of the course went down to 40%, instead of over half before.

The biggest per cent of drop-outs in both 7-year surveys was in our 1-e course, the beginners' non-credit course. It was 95% in the first survey, and 77% in the second. Both figures are too high. Even without getting statements from the enrollees, we think we have the answer. This course, as with all those offered, was designed and written up on the basis of high school graduates. The 3-hour credit course, No. 1-c, was intended for those with some previous high school drawing. Those without high school training were supposed to take the easier course 1-e as an introduction. Somewhere along the way it appeared that the course was about the equivalent of one year of high school drawing. A high school undergraduate be he freshman or senior, could therefore elect it for school credit. Various ones did do just that, from the smaller schools where mechanical drawing class courses were not given. The correspondence course, being written to a level of at least four years more maturity and with a drawing text book normally used in college-level instruction, naturally would be discouraging to high school youth. High school students frequently believe that a drawing course is so simple that they can dash it off to fulfill a last minute high school graduation requirement. Once they receive it and find that they must work on it, they give up. A high school correspondence course demands a type of independence that only average or above average students possess. The playboy or loafer is not very often successful in this type of study. Since the University Extension Service in the meantime had become committed to offering a series of study courses for high school credits, we are now revamping the beginning drawing course entirely, with easier exercises and with a text at high school level. It bears promise that school youth will find this more acceptable, and with good likelihood of completing the assignments. We will later compile figures on this situation.

In the other courses, whether the enrolled students are gradually getting more conscientious and industrious, or whether there is greater appeal and greater clarity in the correspondence publicity and specifications, there seems to be an improved trend. The chances are that the current increased demand for technically trained men reflects a pressure on many individuals to get what technical knowledge they can, in their home town and without leaving current employment. Even those contemplating college attendance are sometimes pleased, in view of present high costs, to be able to get certain college credits while still at home. We may therefore presently look for a gradual increase in correspondence enrollments, though naturally this will be balanced or offset by the trend of more "junior colleges" on the neighborhood level.

Extension Divisions of universities should, either way, be alert to the expressed or anticipated needs of a growing population, and be prepared to offer means of a continuing education to those who can profit by it. For those unable to be in college residence, training in many subjects, drawing included, can be brought to the individual by letting the postman be the intermediary. In fact, the postman might be of more help than anticipated. I read recently where an individual on a remote R.F.D. route received from the Extension Service of a University a folio that was obviously the specifications for a correspondence course. There was a penciled note on the outside which read, "Let me know if you have any difficulty with this course. I have just completed it," signed, "Your mailman."

Exchange Education in Engineering

DONALD J. SHANK

Executive Vice-President
Institute of International Education

A manager of the Thai Sugar Mills in Uttaradit, Thailand, a director of the Traffic Department of the Syrian Telephone and Telegraph Service, a director of the School of Engineering in Monterey, Mexico—these men are representatives of 80,186 foreign students who have studied engineering in the United States during the past ten years.

Engineering is the most popular of all fields of study among foreign students in the United States. It has been in first place since 1955, when the Institute of International Education began publishing *Open Doors,* the annual statistical survey of the academic and medical exchange population. For five years before that, engineering ran second only to the humanities, a broad category covering fields from theology to the fine arts.

Open Doors 1959 reports that of 47,245 students who were enrolled in U. S. colleges and universities in 1958–59 from 131 countries, 10,682 (23%) were in engineering. This, according to the latest available UNESCO figures, means that we are training more foreign engineering students than any country in the world, including the Soviet Union.

The three young engineers mentioned above are typical of those who come to study here, not only in the diversity of their fields but in their nationalities. This year 30% of all foreign engineering students were from the Far East, 26% from Latin America and 22% from the Middle East. These three rapidly industrializing areas have continued throughout the years to send us the largest numbers of engineering students. Nationalist China (including students stranded in the U. S. who are now in universities) and India this past year each accounted for more than a thousand, 847 were from Iran, 697 from Cuba and 482 from Venezuela. We also were training 911 Canadian engineers, 339 Greeks and 255 Africans. The ratio of undergraduate to graduate students in engineering is about 3 to 1 each year.

Why do these students come here instead of going to Europe? The answer is not only the industrial leadership of the United States in today's world, but the general feeling among students that our education is more "practical." Whether it is practical enough, however, is still a question much discussed by many engineering educators. Is it wise, many ask, to give the same training to a student from Indonesia as to his classmate from Indiana, when one will practice engineering in a far less developed economy and industrial setup than the other? Some educators believe that the man from Indonesia would be better served not by a degree course, but by the special project approach now used for a small minority of "special" students.

Instead of working for degrees, special project students bend their efforts toward preparing for specific jobs in their home countries. Their training consists of both classes in theory and extensive field work to see how similar problems are dealt with here. That this is an "over-practical" approach for the great majority of students is argued with equal fervor by other educators, who stress the need for a basic education to prepare the students for problems that may arise far in the future.

The special project approach also seems to assume that the future engineer will work solely on local problems either for his own government or for a local firm. More than half of the foreign engineering students, this year, however, indicated interest in working for the overseas branch of a U. S. firm. A great

many of these came from the Far East and Latin America.

The Institute has on file the names of many students who have found such posts—from a research engineer at IBM in France to a retail assistant at Standard Oil in Cambodia. In order to help the many American firms who are seeking such American-trained foreign personnel, IIE maintains its Roster of Internationally Trained Personnel, a cumulative file of several hundred thousand foreign nationals with American training, as well as Americans who have studied abroad. From it IIE can readily supply, for example, the names of a Lebanese chemical engineer educated at M. I. T. or American civil engineers who have been in Brazil during the past five years. Since the initiation of the Roster in 1953, this service has been made available to about 150 U. S. and foreign industrial concerns, governments, foundations, universities, private organizations and individual research scholars.

The flow of U. S. engineering students to other countries is, as might be expected, much smaller than the influx of their foreign confreres. In recent years they have represented only about 1% of all American students studying abroad. At IIE's Third National Conference on Exchange of Persons last January, a panel of engineering experts pointed up this fact as a real problem.

The panelists, Howard A. Meyerhoff, Executive Director of the Scientific Manpower Commission; John K. Wolfe, Manager of Advanced Degree Personnel at the General Electric Company; Brigadier General Donald Flickinger of Andrews Air Force Base; Thorndyke Saville, Director of the University of Florida's Science and Technology Center, and M. H. Trytten, Director of the Office of Scientific Personnel of the National Academy of Sciences, all agreed that more Americans should be studying engineering abroad. Undergraduates especially, they felt, could gain much from European technical schools' emphasis on basic courses like mathematics. There was also much to be gained, they said, from comparing how Europeans and Americans handle the same problems, not to mention the broadening experience of study abroad on the engineer as a world citizen.

One of the main obstacles to American engineering students studying abroad is the lack of facility with foreign languages. Another is the still limited role of American industry in sponsoring technical educational exchange programs. The panel, as well as many other engineers and educators, voiced hope that more attention will be given to these problems in the future.

Our major responsibility in engineering exchange education, however, is clearly with the increasing number of foreign students coming here each year. Research studies on attitudes toward the United States among our foreign exchange alumni clearly show that the more useful the training they receive, the warmer is their feeling toward us as a nation. How well we educate this large number of foreign engineering students will influence not only the industrial development of important areas of the world, but the number of friends we will have among their technical and other intellectual leaders.

IIT REACTOR POWER INCREASED, JOURNAL ERROR CORRECTED

Approval was recently granted the Illinois Institute of Technology by the Atomic Energy Commission to increase the power output of its nuclear reactor from 10,000 to 100,000 watts. This increase will make IIT's reactor the largest of its type in operation. The Illinois Institute of Technology was the first to possess a reactor for industrial research.

In the October 1959 issue, the JOURNAL listed The Armour Institute as one of those institutions having a non-government reactor. The Armour Institute merged with Lewis Institute in 1940 to become Illinois Institute of Technology. The organization within the Institute which controls the reactor is the Armour Research Foundation.

Graphics in Research

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The chief importance of graphics to original thought is in its power to aid conceptualization. I will give several examples of this, but first I want to say a word about the present state of scientific arts and certain trends that are changing our world and our ways of thinking.

Not many years ago it was customary practice in the aircraft industry to fair the lines of an airplane fuselage by the traditional methods of the ship mold loft. This was a cut-and-try procedure, and to make a surface fair to the high degree of precision required used to be long, tedious, sometimes frustrating. During the Second World War, interest focussed on projective geometry as a means for constructing faired surfaces, so as to substitute science for art as much as possible. By using the techniques of projective geometry, the problem of fairing virtually disappeared. It was possible from a handful of data to define an entire airplane fuselage in an afternoon, and to any degree of precision desired. This task by the older methods of the mold loft would take weeks or months, so you can see that the saving in time and effort was tremendous. But an additional benefit derived from the new method was that the surface so defined could be computed. In those days the modern high speed digital computer was only being invented, so it was customary to "program" a crew of desk calculator operators to perform a series of calculations and to enter their results after each step in a table. In this way it was possible to obtain tables of offsets of sections of the fuselage in a very short time, and by the most automatic and mechanical of methods. This increased the flexibility of the design procedure, because under the new regimen it was not very expensive to make drastic alterations in the fuselage shape if considerations warranted them. In the old tradition, such changes would have meant cutting new lines in the loft floor, and fairing new sections on the body plan, or possibly making a new body plan at prohibitive expense. Under the new system it was only necessary to change a few constants and recalculate a few numbers, a routine procedure. Today, fifteen years later, these methods are still in use, except that the crew of desk calculator operators has been replaced by an IBM 704 computer. Now it is possible to compute an entire fuselage in a few mintues. The designer no longer feels any obligation to stick to his original design in spite of faults that may come to his attention after the lines have been computed, because it is so cheap and easy to change them at will. The result of this freedom of choice is of course better design.

After the war, the major aircraft companies and others got together with the Servo-mechanisms Laboratory people at M.I.T. to work out details of methods for controlling machine tools automatically by computers. This project has been carried on as a joint enterprise, and today has reached a temporary plateau; in the present system, a detailed part from a design layout is described to the computer is a special verbal language, partly numerical, and the computer proceeds to calculate positions that the cutter must take to fabricate the part. Much of the decision-making function of the machine tool operator has been removed, and eventually he will have nothing to do but feed and maintain his ma-

Recommended by the Graphics Division.

chine. The savings in time and cost of production and the increase in precision of such systems are so great that it is possible to pay for the expensive equipment required in a matter of a few months.

The next step now contemplated is to eliminate the special language needed to communicate with the machine, so that it will in a few years be possible to introduce design information into the machine in the form of sketches and instructions about precision, much as we now communicate with a human machinist. A few minutes after this has been done, the machine will begin to produce the part described.

The automatically controlled machine tool is one example of the union of graphical methods with the high speed computer in the field of design. In analysis, the computer is also becoming more and more important and more and more commonplace. I was startled to learn that almost all the large aircraft companies involved in automatic control of machine tools have giant computers; far from being a rare luxury, they appear to be a necessity. You just aren't anybody unless you have a big computer. These computer facilities are of course too expensive for small engineering and research organizations at present, but it will not be long before cost and size will have diminished and scope and flexibility will have increased. Even today excellent analog type computers of remarkable versatility are available for a few thousand dollars.

The computer makes it possible to undertake analyses which only a few years ago would have been beyond the reach of pencil and paper methods, whether graphical or arithmetical. Once a problem has been set up on an analog computer, it furnishes complete solutions repetitively and displays the results on an oscilloscope twenty times a second, or faster if we wish. Once a digital computer has been programmed, it computes tables of results and prints them out to six or more significant figures in minutes. Nor need we introduce simplifying assumptions—we can take into account all factors of a problem just as they occur in nature. We can change the parameters of a problem by merely twisting dials or introducing different punched cards.

In competition with a computer, graphical methods are out of the running. A differential equation that takes two hours to solve by graphical means is solved by a small analog computer so rapidly that its oscilloscope image would disappear in a flash if it were not repeated again and again to produce a persistent retinal image in the eye.

The Use of Graphics

What then is the use of graphics in computation? It turns out that it is very useful indeed, but for the purpose of conceptualizing the problem, not for its actual computation.

Let us turn to a specific problem, one that was given to my freshman class in Graphics last term. A weight rests on a table top. A spring is attached to the weight, and the other end of the spring is pulled along at a constant rate of speed. Between the weight and the table top there is friction which opposes motion; if we want to simplify the problem, we would assume the frictional force to be constant, but if we want a realistic solution we must admit that the friction is greatest when the weight is at rest, and rapidly decreases when the weight begins to move. The friction force is a function of velocity, but a function that we know only empirically—in graphical form. The class solved the descriptive differential equation graphically, and obtained curves of acceleration, velocity, and displacement plotted against time. It took two or three hours, partly because of their inexperience, but the results were in good agreement. Then the problem was set up on an analog computer as a demonstration. The set up time was over an hour, and the graphical solution was used to check results. At first these results were violently in disagreement with the graphical solution, owing to mistakes in the set up, but finally the computer began to give the correct solution. After this correct hookup was obtained, it was of course possible to vary the parameters at will, so as to yield solutions to a variety of related problems, and so as to learn the effects of varying

the mass, spring stiffness, towing velocity, and friction function rapidly. In such variation the new differential equations are solved immediately, about 150,000 times as fast as can be done graphically; but without the original graphical solution or its equivalent it would have been impossible to know whether the computer was giving meaningful answers or merely inventing nonsense at a superhuman rate. The important role of graphics is clearly one of conceptualization, and not of actual computation. It is even possible to sketch solutions freehand to a sufficient degree of accuracy to serve to check the computer, even though these solutions are too rough for anything more than mere qualitative approximations. In research, when we are exploring an unknown system, rough graphical checks are indispensable, even though the final precise solution will be obtained by mechanical computation. After all, in an unknown system we have no idea of what is plausible and believable and what is mere nonsense; our intuition, unaided, can be of no use to us unless we have had previous experience with a similar problem, and in research, by definition, this previous experience is lacking.

In another case a man has just finished his master's thesis on the topic of machine computation of optimum four bar linkages that will fulfill certain input-output crank angle relationships. There are seven variables involved in his problem, including the two crank angles. Four of these variables are used as parameters, and the computer scans these variables, so-to-speak, and determines those values that will allow one of the links to remain constant in length, within certain prescribed tolerances. The actual computation is performed in the machine, but it is based upon a graphical technique involving a nomogram, and before the programming was a success this graphical background was the only criterion that guided the researcher in correcting the many mistakes and false starts that the computer made. Once the program is established and in good working order, the computer can produce results in few minutes, but the hardest task was to make the program work.

As a third example, a recent doctoral thesis has for its object the investigation of stress on an annular toroidal diaphragm, such as would be found as a part of pressure measuring devices. The problem involves a dependent variable which is a function of five others, a dependence which is implicit in a pair of non-linear ordinary second order differential equations. The details of the mathematics of the problem are of no consequence to us, nor am I familiar enough with them to give you any coherent account. The important question that graphics is helping to solve in this case has to do with information storage. Assuming that the computer has been programmed to solve the equations, how do we present the resulting information? Graphs or tables have to be six dimensional in order to contain it; this is not an impossibility, but certainly it is a severe drawback. It happens that there is a mathematical process by means of which we can determine whether or not such a six-dimensional relationship can be broken down into a series of three-dimensional relationships, or at least into two or more relationships of lower dimensionality than six. Such a decision is based upon a graphical analysis of the six-dimensional function, at least in principle, and in principle this analysis can be worked out graphically. In practice the researcher will let the computer deal with the details of the problem, after he has made a few exploratory checks by graphical means. If it turns out that the function can be so broken down, then only four three-dimensional graphs or numerical tables will contain all the information, and this will constitute a most substantial reduction in storage space. Equally important, it will reveal the internal structure of the function in a profoundly illuminating way because three-dimensional functions are better understood by our intuition than are functions of higher dimensionality. On the other hand, it may turn out that the function cannot be broken down; if this is the case, the result will constitute a mathematical proof of impossibility, not merely a failure of the method, and the researcher will in this event know some-

thing else about the nature of the function, even though he is disappointed in the other more attractive possibility. I call your attention to the fact that there is no hope of writing formulas for the results; they are of a most general nature, and can only be recorded as graphical curves or tables of numbers, so there is scarcely any hope of applying ordinary analytical methods to them. Yet even so it is possible to prove theorems about these functions and deduce entirely general results. I also emphasize that the power of graphics in this connection is the power of conceptualization, and not at all its ability to compete with the computer.

In programming a computer it is not unusual to draw up an information flow chart as a first step. The actual details of computer programming are quite complicated (although constant efforts are being made to simplify the process) but it is not at all difficult to follow and understand a graphical chart which shows the arithmetical operations, the logical decisions that the machine must be instructed to make among alternatives, and the general structure of the computation process. From such a chart it is possible to arrive at the actual computer program, by steps that are quite routine and mechanical. The programming art has proceeded to the intermediate stage of making the computer partly responsible for programming itself; eventually it is possible that all of this ultra-bookkeeping will be done by the computer, from graphical flow charts.

A Realistic Attitude

I think we must have a realistic attitude toward graphics, and never claim for it powers that it does not possess. I have cited several examples in which graphics is effective and even indispensable, but I would not give a true perspective of the situation if I neglected to show that in some areas it can be weak. You all know that symbolic logic, or Boolean algebra, if you will, has of recent years been applied effectively to problems in switching circuits. What does this mean? It means that circuit diagrams, graphical devices designed to show interconnections of complicated switching arrangements, are indeed so complicated that attempts to simplify them by direct graphical methods are not as effective or efficient or simple as pure symbolic methods, of an algebraic nature. This is not to claim that graphical methods cannot be worked out that could replace the algebraic techniques (although I think it is unlikely) but merely points out that at present an inherently graphical problem is best dealt with by totally non-graphical means. This is all the more curious and striking when we reflect that the early concepts of symbolic logic were worked out most clearly by graphical devices now known as Venn diagrams in honor of the logician who invented them. The history of modern logic has thus meandered from symbol (words) to graph to symbol again, and it seems at least temporarily to be lodged there. Almost no modern text on symbolic logic has any pictures in it.

Recently a member of our geology staff asked help on a problem (arising in three dimensional stress analysis): given three mutually perpendicular elliptical plane sections of an unknown ellipsoid through its center, find the three principle axes of the ellipsoid. The solution to this problem is known in vector analysis, but it is tedious, and entirely non-graphical. The question was, can descriptive geometry furnish a simple, direct graphical construction? So far I have failed to come up with any satisfactory solution, although of course I can solve it by an equally tedious graphical trial and error procedure, a procedure which is no improvement on vector algebra. If any of you would like to tackle this problem I am sure it would be a worth-while enterprise, but remember that the solution must be simple, and direct; a trial and error solution, unless very easy to perform, is not acceptable. Here is an opportunity for some research in graphics to enlarge the scope of graphics in research.

I think we must all be alert to these opportunities and possibilities, we must all continue to study and explore and learn, so that we can convey some of the excitement and pleasure of studying and

learning to our students. I am convinced that at the precise moment we decide we no longer need to learn, that we know all that is needed to teach graphics, at that precise moment we shall have failed our responsibility to our chosen subject, and in time it will disappear from first-class engineering curricula. This will be infinitely tragic, because graphics will not at that time cease to exist. It will be taught and used, but by others who understand and appreciate its value. It will be taught by physicists and geologists and metallurgists and electrical engineers and all those who are in the process of growth in their subjects. Graphics cannot cease to exist; only the graphics teacher can become extinct.

Teaching Positions Available

ENGINEERING MECHANICS. ASST. or Assoc. Prof. Teach undergraduate and graduate work and participate in research. Expanding graduate program will provide opportunity to develop new courses. Salary and rank determined by education and experience. Apply: Department of Engineering Mechanics, Box 6204, University, Alabama.

STAFF IN ELECTRICAL ENGINEERing. Attractive positions combining teaching (graduate and undergraduate) and research are available. Appointment at any level from assistant professor up, depending on qualifications. A person with interests in electrical energy conversion and modern electrical machines is especially sought, but openings in other fields are available. Applicants must have Ph.D. or equivalent evidence of research potential. Write Chairman, Division of Engineering, Brown University, Providence 12, R. I.

MECHANICAL ENGINEERING teaching positions. Men needed in the fluids-heat transfer-thermodynamics-aerodynamics area, in the theoretical and applied mechanics area, and in nuclear engineering. Large and rapidly growing graduate program through D.Sc. Sponsored research encouraged. No limitations on rank. Salary and rank commensurate with educational background and experience. Apply: C. T. Grace, Mechanical Engineering Department, University of New Mexico, Albuquerque, New Mexico.

CIVIL ENGINEERING-STRUCTURES. Opportunity to head structural division, teaching and directing undergraduate and graduate programs. Attractive possibilities in an expanding graduate and research program. Top salary and rank appropriate to qualifications. Ph.D. preferred. Positions now open. Write to L. M. Laushey, Head, Civil Engineering, University of Cincinnati, Cincinnati 21, Ohio.

MECHANICAL ENGINEERING DEpartment has opening for a man to teach and direct work in machine tools and manufacturing processes. Desire man with interest in research on basic cutting and forming phenomena, and having M.S. or Ph.D. Well equipped laboratory, midwestern location. Write to 50-3, JOURNAL OF ENGINEERING EDUCATION, University of Illinois, Urbana, Illinois.

ASSISTANT PROFESSOR TO TEACH courses in Applied Mechanics and Dynamics. Master's degree preferred. Department of Mechanical Engineering, Oregon State College, Corvallis, Oregon.

POSITIONS AVAILABLE FOR teachers of Electrical and Mechanical Engineering, and for teachers of Mathematics. M.S. degree is the minimum requirement; the Ph.D. is desirable. Salary and rank will depend upon qualifications. Excellent fringe benefits. Apply to: Earle M. Morecock, Chairman, Division of Applied Science, Rochester Institute of Technology, Rochester 8, New York.

ASSIST. PROF., START SEPT. 1960, teach undergraduate courses in thermodynamics, heat power, heat transfer. M.S. degree required, teaching or industrial experience desirable. Write: Chairman, Engr. Dept., Fresno State College, Fresno 26, Calif.

ENGINEERING ADMINISTRATION Program, School of Engineering has positions open beginning February and/or September 1960, for Associate and Assistant Professors of Engineering Administration; Masters degree required, preferably Ph.D.; Salary open. Send qualification record to Professor J. E. Walters, School of Engineering, The George Washington University, Washington 6, D. C.

OPPORTUNITIES AT ROBERT COLlege, in Istanbul, Turkey, for qualified men in civil engineering or mathematics, interested in combining teaching and the development of limited research and consulting activities with the opportunity to live and travel in a vital part of the world; Strengthening staff, modernizing undergraduate engineering curricula, beginning graduate programs in engineering, developing undergraduate and later graduate programs in sciences, constructing new science and engineering building to prepare engineers for the industrial and technological development of Turkey and the Middle East. A challenging job with far-reaching possibilities. Address inquiries to Dean Howard P. Hall of the School of Engineering or Professor Frank Potts, Acting Dean of the School of Sciences, Robert College, Bebek, Post Box 8, Istanbul, Turkey; with copy to the Near East College Association, 40 Worth Street, Room 521, New York 13, New York.

ADDITIONS TO MECHANICAL ENgineering Staff at all professorial ranks. Attractive possibilities in an expanding graduate, undergraduate, and research program. Write to Donald M. Vestal, Jr., Head Professor, Mechanical Engineering, Auburn University, Auburn, Alabama.

ASSISTANT PROFESSOR OF ENGIneering Graphics and Machine Design. $5800–$7100 for nine months. Must have M.S. in Engineering and some professional design experience. Teaching experience desirable. Begin in Fall of 1960, or possibly in Summer (for extra pay.) Delightful surroundings, affable associates. Write to: R. H. Crawford, Head; Department of Engineering Graphics and Machine Design; University of Colorado; Boulder, Colorado.

THE NEW COLLEGE OF ENGIneering of The University of Rochester is seeking additional staff in chemical, electrical and mechanical engineering to do teaching and research. Interested applicants should write to the appropriate department at The University of Rochester, River Campus Station, Rochester 20, New York.

APPLICATIONS ARE INVITED FOR the position of Senior Lecturer in Industrial Engineering: Salary £A2160/£A2510 p.a. Applicants should have an Honors Degree or higher Degree of a recognized University, together with industrial experience in both the technical and administrative fields. The applicant will be required to assist in the research and teaching work in Industrial Engineering at both undergraduate and post-graduate level. Further particulars may be obtained from the Registrar, University of Queensland, Brisbane, Australia, with whom applications close on 30th January, 1960.

EXCELLENT OPPORTUNITIES available at San Jose State College in fields listed below. Located in San Francisco Bay Area, center of expanding research, development and manufacturing activities. Newly accredited curricula and new M.S. programs. Ph.D. completed or in progress and teaching and industrial experience desirable. Contact N. O. Gunderson, Head, Division of Engineering or appropriate department head: Civil, W. W. Lorell; Electrical, J. T. Smith; Mechanical, S. B. Walton; Metallurgical, J. H. Anderson.

College and University Short Courses and Conferences, 1959-1960

Following is a list of short courses and conferences of interest to engineering educators and open to them. This information was compiled by the JOURNAL staff. Plans are now being made for a listing in an early spring issue of such short courses and conferences which are to take place during the summer of 1960. Information concerning any such courses or conferences not already in the present list should be sent to the Editor, JOURNAL OF ENGINEERING EDUCATION, University of Illinois, Urbana, Ill. The material should be sent in immediately if it is to be available before our printing deadline.

Agricultural Engineering

Agricultural Engineering Annual Field Day

Date: Sometime during winter quarter
Objective: Convey research items under Experiment Station in the Agricultural Engineering Department to all people concerned
For: Anyone interested (farmers, business men, etc.)
Limitations: Unlimited
Fee: None
Address: Dennis L. Moe, Head, Department of Agricultural Engineering, South Dakota State College, Brookings, S. Dak.

Forage Practices, Preservation and Utilization, Conference on

Date: October 22, 23, and 24
Objective: Discuss problems in producing, handling, storing and utilizing forages
For: Agricultural Experiment Station Personnel and others (Open to public)
Limitations: Regional
Fee: None
Address: University of Missouri, Columbia, Missouri

Irrigation Clinic

Date: March, 1960
Objective: To relay research data and information relative to irrigation, both technical and demonstrative, to farmers, irrigators, and technical people
For: Irrigation companies, farmers interested in irrigating
Limitations: Unlimited
Address: John L. Wiersma, Agricultural Engineering Department, SDSC, Brookings, S. Dak.

Rural Electric "Power Use Advisors" Conference

Date: October 19, 20, 21, 1959
Objective: To demonstrate and show new methods of farm electricity
For: Technical people, business men interested in electricity, farmers, etc.
Limitations: Technical members, business men concerned with electricity
Address: Wm. H. Peterson, Ag. Engr. Department, South Dakota State College, Brookings, S. Dak.

Soil and Water Conservation Problems and Research, Seminar on

Date: Feb. 28, March 1 and 2; Annual
Objective: Consider results of research in this field; discuss problems needing further study
For: Agriculture Experiment Station and U. S. Department of Agriculture Personnel
Limitations: National
Fee: None
Address: Department of Agricultural Engineering, University of Missouri, Columbia, Missouri

Rural Electric "Power Use Advisors" Conference
Date: October 19, 20, 21, 1959
Objective: To demonstrate and show new methods of farm electricity
For: Technical people, business-men interested in electricity, farmers, etc.
Address: Wm. H. Peterson, Ag. Engr. Department, South Dakota State College, Brookings, So. Dak.

Agricultural Engineering Annual Field Day
Date: Some time during Winter Quarter
Objective: Convey research items under experiment station in the Agricultural Engineering department to all people concerned
For: Anyone interested (farmers, business-men, etc.)
Fee: None
Limitations: Unlimited
Address: Dennis L. Moe, Head of Ag. Engr. Dept., South Dakota State College, Brookings, So. Dak.

Irrigation Clinic
Date: March, 1960
Objective: To relay research data and information relative to irrigation both technical and demonstrative to farmers, irrigators and technical people
For: Irrigation companies, farmers interested in irrigation
Limitations: Unlimited
Fee: None
Address: John L. Wiersma, Ag. Engr. Dept., South Dakota State College, Brookings, So. Dak.

Architecture and Architectural Engineering

Annual Conference for Engineers and Architects
Date: May, 1959
Address: Marion L. Smith, Associate Dean, College of Engineering, 140 W. 18th Ave. OSU, Columbus 10, Ohio

Architects' Problems
Date: June 2–3, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Architectural Engineering Conference
Date: April, 1960
Objective: "Refresher" course for experienced architects
For: Architects
Limitations: Iowa
Fee: $20.00
Address: Engineering Extension, Iowa State University, Ames, Iowa

Ceramics

Lightweight Aggregate Conference
For: engineers, technologists, production and administrative
Address: Prof. J. O. Everhart, Chairman, Dept. of Ceramic Engrg., 126 Lord Hall, 124 W. 17th Ave., OSU, Columbus 10, Ohio

Shop Practice Forum Porcelain Enamel Institute
Date: November 4, 5, 6, 1959—alternate years with Annual Glass Conference
Objective: In-service refresher
For: Plant operators and supervisors
Fee: $15 for member company representatives, $35.00 for non-members
Address: Professor R. M. King, Dept. of Ceramic Engrg., 126 Lord Hall, 124 W. 17th Ave., OSU, Columbus 10, Ohio

Clay Plant Operators' Forum, Southeastern

Date: Annual event—October 19–21, 1959
Objective: Designed to fill the needs of production supervisory personnel and ceramic engineers active in the structural clay products industry
For: College-trained ceramic engineers and non-technical supervisory personnel
Limitations: Regional
Fee: $15.00
Address: College Extension Division, P. O. Box 5125, State College Station, Raleigh, N. C.

Chemical Engineering

Automatic Control in the Petroleum and Chemical Industries

Date: April 25–26, 1960
Objective: To introduce automatic control techniques which can be applied directly to industrial problems
Fee: $10.00
Address: M. L. Powers, Director, Bus. & Ind. Services, Extension Division, University of Oklahoma, Norman, Okla.

Chemical and Metallurgical Refresher

Date: February 25–26, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Instrumentation for the Process Industries

Date: 15th Annual Symposium—April 20, 21, 22, 1960
Objective: To present new knowledge in instrumentation
For: Technical men in process industries
Limitations: About 400 attend from all over the country
Fee: $10.00. Paid by employers or individuals
Address: Chemical Engineering Dept., Texas A. and M. College, College Station, Tex.

Marine Chemists Conference

Date: March 1960 (Probably March 16–18, 1960) This is the second annual Conference
Objective: To inform marine chemists about latest techniques in testing and handling hazardous cargoes
For: Marine chemists and any other interested persons
Limitations: Primarily for members of Marine Chemists Assn.
Fee: $15
Address: Department of Conferences and Institutes, University, Mississippi

7th Annual Joint Meeting, ACS–AIChE

Date: March 11, 1960—annually
Objective: Present recent advances in chemistry and chemical engineering
For: Chemical engineers, chemists, and faculty
Limitations: Regional, but no real limitations
Fee: Registration: $2.00 no stipends
Address: Dr. S. D. Smith, E. I. Du Pont de Nemours Co. Box 2027, Orange, Texas (Lamar State College of Tech.)

Solutions to Chemical Engineering Problems by the Use of Computers

Date: Friday, April 22, 1960 (annual regional AIChE symposium)
Objective: To acquaint chemical engineers with computer solutions to specific chemical engineering problems
For: Chemical engineers and other interested parties
Limitations: Regional
Fee: Not yet known
Address: Prof. George D. Moon, Jr., Dept. of ChE&Met Engr'g, University of Cincinnati, Cincinnati 21, Ohio

City Engineers and Community Development

City and Regional Planning Conference

Date: October 5–6, 1959
Objective: To familiarize interested groups with what city planning is and what it can do for a community
For: Municipal officials, supervisors, engineers, commissioners, etc.
Limitations: No limitation
Fee: $8.00 (includes two formal meals)
Address: Department of Conferences and Institutes, University, Mississippi

City Engineers Conference—Annual

Date: March 16–17, 1960–Annual
Objective: Illustrated discussion of technical and policy problems
For: City engineering departments
Limitations: Iowa
Fee: $10.00
Address: Engineering Extension, Iowa State University, Ames, Iowa

Community Development Conference

Date: November 13–14, 1959
Objective: To arouse interest in community development, show techniques that may be used in solution of problems, and to indicate services available through the University
For: Community leaders, such as local government officials and leaders of service, fraternal, and civic organizations
Fee: $6.00
Address: Prof. B. E. Munson, Supervisor, Community Development, 204 Engr. Experiment Station, 156 W. 19th Ave., OSU, Columbus 10, Ohio

Maintenance of Municipal Equipment

Date: April 5–6, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Civil Engineering (see also more specific headings)

American Society of Civil Engineers, Tennessee Valley Section

Date: November 13 and 14, 1959
Objective: To discuss by means of panels and speeches the most current trends in civil engineering practice
For: Tennessee members and Tennessee Valley Section Members, which includes several other states. Sponsored by the Civil Engineering Department, UT
Address: Conference will be held at the University Center, University of Tennessee. Further information may be obtained by writing to Professor E. S. Fabian, Head, Civil Engineering Department Room 117, Perkins Hall, University of Tennessee, Knoxville, Tenn.

Contractors' Supervisors, Short Course

For: In-service refresher for construction superintendents (mostly graduate engineers)
Fee: $60.00
Address: Professor E. H. Karrer, Dept. of Civil Engrg., OSU, Brown Hall, 190 W. 17th Ave., Columbus, Ohio

County Engineers Conference

Date: November 30–December 2, 1959–Annual
Objective: Presentation of research and study papers
For: County and highway engineers
Limitations: Iowa
Fee: $15.00
Address: Engineering Extension, Iowa State University, Ames, Iowa

General Contractors
Date: November 10–11, 1959
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Structural Engineering Conference
Date: November 13, 1959
Objective: To consider new aspect of concrete research and design
For: Structural engineering teachers and practicing structural engineers
Limitations: None
Fee: $3.00
Address: Department of Civil Engineering, University of Colorado, Boulder, Colorado

Tennessee Public Works Association
Date: Annual
Address: University of Tennessee, Knoxville, Tenn.

Computers

Digital Computer Applications Symposium, 2nd Annual
Date: November 5–6, 1959
Objective: Education
For: Users of electronic computers
Limitations: Regional
Fee: $10.00
Address: Lee Brogan, Denver Research Institute, University of Denver, Denver, Colo.

Network Analyzer Short Course
Date: September 8–10, 1959—Annual
Objective: Postgrad level instruction regarding network analyzer method of solving power transmission problems
For: Electric power and consulting engineers
Limitations: International
Fee: $50.00
Address: Engineering Extension, Iowa State University, Ames, Iowa

Concrete

Concrete Conference
Date: December 11–12, 1959
Objective: Current research and new developments in the use of concrete
For: Concrete engineers
Fee: $7.50 registration and tuition
Address: Center for Continuation Study—University of Minnesota, Minneapolis 14, Minn.

Concrete Conference
Date: Not set—December 1959 or January 1960
Objective: To furnish the latest information on concrete to engineers and contractors
For: Engineers and contractors (two days)
Limitations: None
Fee: $5.00
Address: W. H. Rowan, Box 1603, Vanderbilt University, Nashville, Tenn.

Concrete Conference, Annual
Date: Selected each year
Objective: To educate engineers in the latest problems and methods of the concrete industry
For: Professional engineers, architects, and contractors
Fee: $3
Address: Concrete Conference, c/o E. L. Lium, University of North Dakota, Grand Forks, North Dakota

Quality Concrete Conference
Date: Annual event—December 8–9, 1959
Objective: Technical discussions of latest developments in concrete methods
For: Engineers, contractors, and sales representatives
Limitations: Statewide
Fee: $5.00
Address: College Extension Division, P. O. Box 5125, State College Station, Raleigh, N. C.

Quality Concrete Short Course
Date: January 11, 12, 13, 1960
Objective: Improve knowledge of contractors and inspectors in making quality concrete
For: Contractors, Inspectors, Engineers, Students in Civil Engineering
Limitations: Regional (Ohio), although not limited
Fee: Unknown at present, but will be limited to only cover expenses
Address: Prof. Louis M. Laushey, Head, Dept. of Civil Engineering, University of Cincinnati, Cincinnati 21, Ohio

Ready-Mix Concrete
Date: March 22–23, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Corrosion

Corrosion Control
Date: January 12–13, 1960
Objective: To study corrosion control
For: Field and technical personnel in refinery, oil field, and pipe line operations
Fee: $15.00
Address: M. L. Powers, Bus. & Ind. Serv., Extension Division, University of Oklahoma, Norman, Okla.

Metal Corrosion Conference
Date: Annual
Address: University of Tennessee, Knoxville, Tenn.

Design

Plastic Design in Steel
Date: October 7, 14, 21, 28, November 4, 11
Objective: Practical applications of new design methods
For: Engineers and architects
Limitations: None
Fee: $5.00
Address: Raymond J. Kipp, Director of Engineering Institutes, Marquette University, Milwaukee 3, Wisconsin

Plastic Design of Steel Structures
Date: September 28–November 2, 1959
Objective: Present to practicing engineers principles of plastic design
For: Graduate engineers
Limitations: None
Fee: $5.00
Address: C. F. DeVilbiss, Box 1565, Vanderbilt University, Nashville, Tenn.

Electrical Engineering

Automatic Control Conference, National
Date: November 4–6, 1959 (once only)
Objective: Technical Program on Automatic Control

For: Engineers interested in feedback control systems
Limitations: National
Fee: $5.00
Address: Department of E.E., Southern Methodist University, Dallas, Texas

Circuit Theory, 4th Midwest Symposium on
Date: December 1–2, 1959
Objective: Annual meeting
For: Midwest
Limitations: None
Fee: $40 complete or $20 without housing
Address: Stanley Krupnik, Jr., Marquette University, Milwaukee, Wisconsin

Conference for Protective Relay Engineers
Date: April 11–16, 1960 (annual conference)
Objective: To provide an opportunity for the discussion of problems in design, application and operation of protective relay equip. as applied to electrical transmission lines and electrical machinery
For: Electrical Engineers
Limitations: None
Fee: $10.00
Address: L. M. Haupt, Conf. Chairman, E. E. Dept., Texas A. and M. College, College Station, Tex.

Electrical Contractors
Date: February 11–12, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Electrical Engineering Refresher
Date: April 28–29, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Electrical Equipment for the Textile Industry
Date: An annual meeting to be held in Charlotte, N. C., Oct. 15–16, 1959
Objective: For discussions of technical problems common to the textile industry and the electrical engineering field
For: Electrical engineers and textile industrialists
Limitations: National
Fee: Not determined
Address: Mr. E. R. Davis, Chairman, AIEE-Textile Conference, Duke Power Company, Charlotte 1, N. C.

Electronics Industries Association—Conference on Value Engineering (Univ. of Pennsylvania)
Date: October 6–7 Annual
Address: J. A. Caffiaux, Staff Engineer, 650 Salmon Tower, 11 W. 42nd St., New York 36

Electric Meters
Date: March 10–11, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Industrial Power Systems
Date: January 21–22, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Panel discussion for students during IRE Conference on Airborne and Navigational Electronics
Date: October 26–28, 1959
Objective: Opportunities for engineers today and tomorrow
For: Student engineers
Limitations: Local
Fee: None
Address: Dr. William H. Huggins, Johns Hopkins University, Baltimore 18, Md.

Symposium on Engineering Aspects of Magnetohydrodynamics
Date: February 18–19, 1960
For: Experts in this field
Limitations: Number limited to approximately 200
Fee: $7.00 in advance, $9.00 at door
Address: Dr. Ralph M. Showers, University of Pennsylvania, Moore School, Philadelphia 4, Pa.

Foundations of Future Electronics (weekly lecture series)
Date: Sept. 1959–January 1960. Single offering. Concurrently at Los Angeles, San Diego, Corona, and Menlo Park, California
Objective: To present current thinking and to develop insights on those scientific areas likely to have impact on electronics of the future
For: Working engineers, applied scientists, and teachers
Limitations: Capacity at each location; no partial registrations accepted
Fee: $45; no stipends
Address: University Extension, University of California, Berkeley 4 (for Menlo Park series) or Los Angeles 24, California (for other series)

Fluid and Solid Mechanics

Advanced Principles of Flow Measurement, Short Course
Date: September 15–17, 1959—annually
Objective: In-service
For: Research personnel of educational institutions, industrial and governmental organizations
Fee: $50.00
Address: Professor Samuel R. Beitler, Dept. of Mechanical Engineering, Robinson Lab., 206 W. 18th Ave., OSU, Columbus 10, Ohio

Fluid & Solid Mechanics, Midwestern Conference
Date: September 9 to 11. (Annually)
Objective: Fluid and Solid Mechanics
For: Engineers
Limitations: National
Fee: $15.00
Address: Dr. M. J. Thompson, Dept. of Aero-Space Engineering, The University of Texas, Austin 12, Texas

Heating, Air Conditioning, Refrigeration

Air Conditioning and Refrigeration
Date: November 12–13, 1959
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Conference on Air Conditioning, Kansas State University
Date: Not yet established
Objective: Exchange recent information
For: Consulting engineers, architects, contractors, equipment manufacturers
Limitations: None
Fee: Registration $15.00
Address: R. G. Nevins, Dept. of Mechanical Engineering, KSU, Manhattan, Kansas

Forced Warm Air
Date: March 28–31, 1960—Annually
Objective: Promote better design and installation of forced warm air heating and air conditioned systems
For: Dealers and Manufacturers
Fee: $40.00
Address: Forced Warm Air Conference, Continuing Education Service, Kellogg Center, Michigan State University, East Lansing, Mich.

Hydronics Conference
Date: April 11–14, 1960
Objective: To train dealers, jobbers, installers, contractors, engineers and architects in approved techniques of hot water and steam heating and air conditioning
For: Regional conf. dealers, jobbers, installers, contractors, engineers and architects
Address: Hydronics Conference, Continuing Education Service, Michigan State University, East Lansing, Mich.

Steam and Hot Water Heating
Date: April 27–29, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Warm Air Heating
Date: April 19–22, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Warm Air Heating and Air Conditioning
Date: April 1–4, 1960
Objective: To present latest methods in this field
For: Heating engineers and distributors
Limitations: New England region
Fee: $35.00
Address: University of Connecticut, Storrs, Conn.

Warm Air Heating and Air Conditioning Short Course
Date: February 22–25, 1960 (annual event)
Objective: To promote better design and installation of warm air heating systems and air conditioning systems
For: Anyone engaged in contracting, installation, sales, or design in this field
Limitations: Of national interest
Fee: Course tuition is $35.00 per person
Address: College Extension Division, P. O. Box 5125, State College Station, Raleigh, N. C.

Highways and Streets

Arizona Conference on Roads and Streets (Ninth Annual)
Date: November 20–21, 1959
Objective: For the exchange of information and ideas pertinent to the highway field
For: Engineers and administrators
Limitations: A state conference with some participation by regional and national personnel
Fee: $3.00 registration fee. College will bear expense of about $700.00
Address: John C. Park, General Chairman, College of Engineering, The University of Arizona, Tucson, Arizona

Asphalt Conference, 2nd Annual
Date: November 3, 1959
Objective: An up-to-date analysis of new methods and materials
For: Contractors, designers, operators

Limitations: Regional attendance expected
Fee: $1.00
Address: Raymond J. Kipp, Director of Engineering Institutes, Marquette University, Milwaukee 3, Wisconsin

Asphalt Paving Conference, 8th
Date: March 31, 1960—Annually
Objective: To improve asphalt construction, content, and study new developments
For: State, county, city engineers, contractors, county officials, state highway department people
Fee: $2.00
Address: 8th Asphalt Paving Conference, Continuing Education, Kellogg Center, Michigan State University, East Lansing, Mich.

Bituminous Conference
Date: November 11, 1959
Objective: To discuss bituminous constructions, methods and materials research and practice
For: Bituminous engineers
Fee: $7.50 registration and tuition
Address: Center for Continuation Study, University of Minnesota, Minneapolis 14, Minn.

Highway Conference, 42nd Annual Tennessee
Date: April 7–8, 1960
Objective: To bring recent developments in highway engineering to a large body of technically interested persons
For: State Highway Department personnel, county and city personnel, contractors, etc.
Limitations: Tennessee and immediately adjacent states
Fee: $4.00
Address: 101 Perkins Hall, University of Tennessee, Knoxville, Tenn.

Highway Conference, Mississippi
Date: February 1960 (Tentative dates Feb. 25–26) Annual Conference
Objective: To inform all participants of latest developments in highway construction
For: Engineers, contractors, highway department personnel, supervisors
Limitations: There are no limitations on registration
Fee: A fee of $15 is charged to cover expenses of the conference
Address: Department of Conferences and Institutes, University, Mississippi

Highway Conference, 13th Annual Virginia
Date: 28–29–30 October 1959
Objective: The Role of the Interstate Highway in Virginia
For: Highway engineers, equipment mfgrs., related industry
Limitations: Generally draws from W. Va., Md., N. C., Va., and Wash., D. C.
Fee: None
Address: Department of Civil Engineering, V.M.I., Lexington, Va.

Highway Engineering
Date: February 17–19, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Highway Engineering Conference
Date: May 5–6, 1960
Objective: All persons interested in highway problems
For: Engineers, contractors, highway officials, etc.
Limitations: None
Fee: $5.00
Address: Professor Frank Bromilow, College of Engineering, New Mexico State University, University Park, New Mexico

Highway Engineering Conference, Annual Ohio
Objective: Refresher for engineers of State Highway Dept., counties, cities, etc.
Address: Prof. E. H. Karrer, Dept. of Civil Engrg., 190 W. 17th Ave., OSU, Columbus 10, Ohio

Highway Engineering Conference, Kansas
Date: March 24–25, 1960
Objective: Exchange recent information
For: State and county highway engineers
Limitations: None
Fee: $2.25 for banquet (usually)
Address: R. F. Morse, Dept. of Civil Engineering, KSU, Manhattan, Kansas

Highway Engineering Conference, 33rd Annual
Date: February 25–26, 1960
Objective: To consider recent research and design in highway engineering
For: Engineering teachers and practicing highway engineers
Limitations: None
Fee: None
Address: Department of Civil Engineering, University of Colorado, Boulder, Colorado

Highway Maintenance Institute
Date: April 27–29, 1959, annually (Dates for this year's Institute have not been set finally)
Objective: To present the latest developments in the maintenance of county roads, streets, and storm drains
For: Superintendents of highway maintenance
Limitations: None
Fee: $25.00 per person
Address: Director of Institutes, University College, University of Maryland, College Park, Md.

Highway Short Course
Date: March 1960
Address: University of Arkansas, Fayetteville, Ark.

Highway Short Course
Date: March 7–10, 1960 (annual, 34th)
Objective: Acquaint the highway engineers with latest engineering techniques
For: All personnel interested in highway design, construction, maintenance
Limitations: None
Fee: $2.00 per person
Address: C. J. Keese, Prof., Dept. of Civil Eng., Texas A. and M. College, College Sta., Tex.

Hydro-Electric Plant Operation

Hydro-Electric Plant Operation
Date: January 18–20, February 1–3, February 15–17, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Industrial Engineering and Management

Advanced Quality Control Conference
Date: For two weeks in April 1960
Objective: To give people the latest methods in this field
For: Industrial engineers
Limitations: National
Fee: $300.00
Address: University of Connecticut, Storrs, Conn.

Business Management Institute

Date: Wednesday evenings, March 31—May 19, 1959; annually. (Dates for this year's Institute have not been set finally)
Objective: To develop certain of the basic management skills resulting in better planning, organizing, and controlling the work of the business organization
For: Management personnel primarily, but attended profitably by engineers who function as section supervisors and are interested in management techniques and principles
Limitations: Registrations limited to fifty persons
Fee: $50.00 per person
Address: Director of Institutes, University College, University of Maryland, College Park, Md.

Developing Executive Abilities of Engineers

Date: September 24–25, 1959
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Effective Drafting Management

Date: April 7–8, 1959
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Effective Drafting Management

Date: October 8–9, 1959
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Engineering Management

Date: November 5–6, 1959
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Engineering Management—Product Industries

Date: May 12–13, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Industrial Engineering and Statistics

Date: Annual
Address: University of Tennessee, Knoxville, Tenn.

Industrial Engineering—Practices and Problems

Date: May 3–4, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Industrial Management Conference, 13th Virginia

Date: To be decided definitely during October: Annually held on a Thursday and Friday in April
Objective: "Improving Industry's Relations with . . . ."*
For: 1st and 2nd echelon management
Limitations: Generally draws only from Virginia Industry—out-of-state speakers
Fee: $12 includes registration, lunch, social hour
Address: Department of Civil Engineering, V.M.I., Lexington, Va.

Inspection Organization

Date: December 8–9, 1959
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Manufacturing Cost Estimating

Date: October 13–14, 1959
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Manufacturing Management

Date: 16 weeks, starting Tuesday, October 6, 1959, 7:00 p.m., Room 234 Engineering
Objective: Industrial engineering survey course from the viewpoint of practical management
For: Present and potential managers and supervisors
Limitations: For credit, must meet prerequisites (Write Department)
Fee: $45.00 for credit, $30.00 non-credit for a shorter course
Address: Department of Industrial Engineering, University of Missouri, Columbia, Mo.

Material Handling for Cost Reduction

Date: October 27–28, 1959
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Operations Research and Systems Engineering

Date: June 8–19, 1959—Annually
Objective: Overall view of OR–SE for industry, business, government personnel
For: Executives, research personnel
Limitations: National
Fee: $300.00
Address: Dr. Eliezer Naddor, Johns Hopkins University, Baltimore 18, Md.

Operations Research Conference

Date: For two weeks in May 1960
Objective: To offer the latest and most up-to-date methods in this field
For: Industrial engineers
Limitations: National
Fee: $300.00
Address: University of Connecticut, Storrs, Conn.

Plant Engineering Management

Date: December 10–11, 1959
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis .

Product Design and Development

Date: March 3–4, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Time Study Fundamentals

Date: April 19–22, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

12th Annual Industrial Engineering Institute
Date: Feb. 5–6, 1960. Annual (alternately at Berkeley and Los Angeles)
Objective: To present latest developments in research and practice
For: Industrial engineers and managers, and teachers
Limitations: None
Fee: $30 (includes Proceedings and two luncheons); no stipends
Address: Engineering and Sciences Extension, University of California, 2451 Bancroft Way, Berkeley 4, California

Industrial Techniques and Applications

Electric Meter School
Date: October 7–8–9, 1959
Address: University of Arkansas, Fayetteville, Ark.

Electroplating Seminar
Date: May, 1960 (1 day)
Objective: Acquaint industrialists with the latest results of research and development in electroplating
For: Business executives, supervisory personnel and technicians in the jewelry and plating industry
Limitations: None
Fee: $4.00–$5.00 Registration Fee which includes cost of luncheon
Address: Either University of Rhode Island, Kingston, R. I. or Sheraton-Biltmore Hotel, Providence, R. I.

Home Builders
Date: December 12–13, 1959
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Industrial Adhesives Applications
Date: October 1–2, 1959
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Industrial Fastener Applications
Date: November 19–20, 1959
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Industrial High-Speed Photography
Date: October 20–21, 1959
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Industrial Lubrication Conference
Date: November 3–4, 1959 (Annual)
For: Engineering, Maintenance, Operations, and Research and Development Personnel
Address: University Center, University of Tennessee, Knoxville, Tenn.

Industrial Packaging
Date: October 29–30, 1959
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Midwest Gas Conference

Date: August 26–28, 1959—Annual
Objective: Papers presented of current interest to "operations engineers"
For: Of gas utilities
Limitations: More than eight states
Fee: $12.00
Address: Engineering Extension, Iowa State University, Ames, Iowa

Motor Fleet Supervisors Institute

Date: April 4–8, 1960, 8:00 a.m. to 4:50 p.m.; annually
Objective: To develop supervisory personnel within the motor vehicle fleet
For: Motor fleet supervisors
Limitations: Registrations limited to one hundred persons
Fee: $25.00 per person
Address: Director of Institutes, University College, University of Maryland, College Park, Md.

Western Industrial Isotope Conference

Date: February 3–5, 1960. Single offering
Objective: To broaden industrial understanding and use of radiosotopes and radiation
For: Industrialists and teachers
Limitations: None
Fee: Undetermined; no stipends
Address: Engineering and Sciences Extension, University of California, 2451 Bancroft Way, Berkeley 4, California

Manpower and Utilization

Conference on Utilization of Engineers and Scientists

Date: October 22 and 23, 1959
Objective: To discuss and disseminate methods for better utilization of engineers and scientists
For: Engineers and scientists, supervisors, and management personnel
Limitations: None
Fee: $30.00
Address: Department of Industrial Engineering, University of Missouri, Columbia, Mo.

Engineering Manpower and University Services Conference

Date: May or June, 1960 (2 days)
Objective: To determine more effective methods to utilize engineers and university services pertaining to engineering
For: Business executives, engineering administrators and educators
Limitations: None—Except that there are subjects that are specifically "geared" to problems encountered by local industries
Fee: $25.00 includes all meals, banquet and overnight lodging
Address: University of Rhode Island, Kingston, R. I.

Invitational Conference on Engineering for High School Students

Date: Annually
Objective: Career orientation for high school students. Information to aid high school teachers in counseling
For: High school juniors and seniors of superior potential. High school science teachers
Address: Paul T. Yarrington, Asst. Dean, College of Engineering, 140 W. 18th Ave. OSU, Columbus 10, Ohio

Mathematics, Statistics

Annual Symposium on Engineering Mathematics

For: In-service
Address: Professor A. B. Bishop, Dept. of Industrial Engineering, 190 W. 19th Ave. OSU, Columbus 10, Ohio

Industrial Statistics Applications
Date: January 20–22, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Mechanical Engineering (see also more specific headings)

ASME—Textile Engineering Conference
Date: March 31–April 1, 1960 (annual event)
Objective: Discussion of engineering advances in textile design and in processing machinery
For: Textile industrialists and mechanical engineers
Limitations: National
Fee: Has not been determined
Address: College Extension Division, P. O. Box 5125, State College Station, Raleigh, N. C.

Foundry Practices
Date: May 17–18, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Gas Compressor Engines
Date: October 20–21, 1959
Objective: Problems facing operating personnel
Address: M. L. Powers, Bus. & Ind. Serv. Extension Division, University of Oklahoma, Norman, Okla.

Industrial Engines
Date: September 22–23, 1959
Objective: A look into the future of reciprocating and gas turbine engines
For: Maintenance, supervisory and field personnel using engines of 600 RPM and up
Fee: $10.00
Address: M. L. Powers, Business & Industrial Services, Extension Division, University of Oklahoma, Norman, Okla.

Steam Plant Operation
Date: October 22–23, 1959
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Welding
Date: November 18–20, 1959
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Mining

Mining Short Course
Date: October 12, 1959–December 11, 1959–Three evening classes per week
Objective: An introductory course in geology, mineralogy and mining and milling
For: All interested persons
Limitations: No academic limitations
Fee: $10.00–$14.00
Address: Box 4001, College, Alaska

Mining Symposium
Date: January 12–13, 1960
Objective: To discuss Lake Superior ores in relation to the world market

For: Mining engineers and operators
Fee: $10.00 registration and tuition
Address: Center for Continuation Study, University of Minnesota, Minneapolis 14, Minn.

Miscellaneous

American Society of Quality Control
Date: Annual
Address: University of Tennessee, Knoxville, Tenn.

Clay Conference
Date: October 12, 13, and 14, 1959
Objective: Field trip and laboratory visits
For: Representatives of academic institutions, industrial employees, students
Fee: Sliding scale, $2.00 to $25.00
Address: Dr. Charles G. Dodd, College of Engineering, University of Oklahoma, Norman, Okla.

Conference—Atomic and Molecular Gas Beams, 1st Annual
Date: May 12–13, 1960
Objective: Education—latest research and development
For: Researchers
Limitations: National
Fee: Not determined
Address: Hack Arroe, Denver Research Institute, University of Denver, Denver, Colo.

Conference of Co-op Division, ASEE
Date: January 14–15, 1960
Objective: Annual meeting
For: Members of co-op division and those actively engaged in co-op work
Limitations: National meeting
Fee: Not established yet
Address: Director, Short Courses and Conferences, Georgia Tech, Atlanta 13, Ga.

Institute for Consulting Engineers
Date: January 25–26, 1960
Objective: Laws, policies-practices
For: Consulting engineers
Fee: $25.00 registration and tuition
Address: Center for Continuation Study, University of Minnesota, Minneapolis 14, Minn.

Instrumentation Conference, Eighth Annual
Date: November 5–6, 1959—Annually
Objective: To keep engineers abreast of new developments in the field of instrumentation and its application to process control
For: Anyone interested in the field of instrumentation
Limitations: None
Fee: $6.00 registration fee and $4.00 banquet ticket (banquet optional)
Address: Box 255, Tech Station, Ruston, Louisiana (La. Poly. Inst.)

Metallography (Milwaukee)
Date: March 31, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Research Conference
Date: April 1, 1960
Objective: New developments in science
For: Industrial leaders

Limitations: None
Fee: $25.00 including all costs
Address: Morgan Hall, Worcester Polytechnic Institute, Worcester, Mass.

Roadside Development, Eighteenth Short Course
Date: October 6–9, 1959 annually
For: Landscape architects and maintenance engineers of the state highway departments, landscape contractors and nurserymen
Address: Prof. C. R. Sutton, School of Landscape Architecture, 118 Brown Hall, 190 W. 17th Ave., OSU, Columbus 10, Ohio

Technical Report Writing
Date: January 20–22, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Strain Gage, Lectures and Laboratory—Photo Elasticity
Date: August 15–September 2, 1960
Objective: Formal instruction in the techniques of electrical resistance strain gages
Fee: $150
Address: UCLA, Engineering Extension, Engineering Building, Unit II, Room 6266

Advanced Infrared
Date: Summer 1960
Objective: A consideration of advanced topics in the field of infrared radiation and detection
For: Graduate, professional, fully employed engineers
Fee: $150.00 for two weeks
Address: University of California, Los Angeles, Engineering Extension, Engineering Building, Unit II, Room 6266

Infrared Radiation and Detection
Date: Summer 1960
Objective: To cover the theory of application of infrared radiation and detection
Fee: $150
Address: University of California, Los Angeles, Engineering Extension, Engineering Building, Unit II, Room 6266, Los Angeles, Calif.

Metal Forming
Date: Summer 1960
Objective: To explore in full the theory of metal forming
Fee: $150
Address: University of California, Los Angeles, Engineering Extension, Engineering Building, Unit II, Room 6266, Los Angeles, Calif.

Thermo-chemistry of Rocket Propulsion
Date: Summer 1960
Objective: To provide material applicable to the work of those engineers concerned with the design, development and analysis of rocket propulsion power from the point of view of thermochemical principles
Fee: $150
Address: UCLA, Engineering Extension, Engineering Building, Unit II, Room 6266, Los Angeles, Calif.

Nuclear Rocket Propulsion Systems
Date: Summer 1960
Objective: To consider in full rocket propulsion systems
Fee: $150
Address: UCLA, Engineering Extension, Engineering Building, Unit II, Room 6266, Los Angeles, Calif.

Oral Communications for Scientists and Engineers
Date: Summer 1960
Objective: Speech analysis
Fee: $150
Address: UCLA, Engineering Extension, Engineering Building, Unit II, Room 6266, Los Angeles, Calif.

Petroleum Engineering

Gas Conditioning
Date: March 2–3, 1960
Objective: Gas dehydration, sour gas treating and gas cleaning
Fee: $10.00
Address: M. L. Powers, Director, Bus. & Ind. Services, Extension Division, University of Oklahoma, Norman, Okla.

Petroleum Research Seminar
Date: February 9–10, 1960
Objective: Pin-point up-to-date advancements of petroleum research
For: Representatives of university, industry, and government agencies
Fee: $25.00
Address: M. L. Powers, Bus. & Ind. Serv., Extension Division, University of Oklahoma, Norman, Okla.

Southwestern Gas Measurement Short Course
Date: April 19, 20, 21, 1960
Objective: Improve measurement, regulations, etc. of natural gas
For: Natural gas employees, educators, etc.
Fee: No fee charge for educators
Address: W. H. Carson, College of Engineering, University of Oklahoma, Norman, Okla.

Plastics

Advances in Plastics Molding Technology
Date: October 6–7, 1959
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Industrial Plastics Conference
Date: September 17–18–19, 1959 (only once)
Objective: To introduce the properties, uses and fabrication of plastics
For: Businessmen and engineers
Limitations: Southwest
Fee: $23.00 registration fee
Address: Howard A. Baldwin, Director, Applied Research Laboratory, The University of Arizona, Tucson, Ariz.

Plastics
Date: May 19–20, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Refresher Courses

Basic Engineering Refresher
Date: October 15–16, 1959
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Civil Engineering Refresher

Date: January 14–15, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Engineers Refresher Course

For: Engineers in industry who are preparing for registration as professional engineers
Fee: $50.00
Address: Prof. Paul F. Graham, Dept. of Engrg. Mechanics, 209 Communications Lab., 215 W. 19th Ave., OSU, Columbus 10, Ohio

Mechanical Engineering Refresher

Date: March 24–25, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Preparation for P.E. Exams (Engineering Refresher Courses)

Date: October 15–16, 1959 Basic Engineering; Jan. 15–16, 1960 Civil Engineering; Feb. 25–26, 1960 Chemical & Metallurgical Engineering; March 24–25, 1960 Mechanical Engineering; April 28–29, 1960 Electrical Engineering
Objective: Review engineering fundamentals
For: Engineers in the specialties indicated above
Limitations: None
Fee: $25.00 for initial two-day session—$15.00 for any additional two-day session
Address: Engineering Institutes, University Extension Division, University of Wisconsin, Madison 6, Wis.

Safety

Advanced Safety Engineering

Date: February 29–March 1, 1960
Objective: Not yet determined
For: Safety engineers
Fee: $25.00 registration and tuition
Address: Center for Continuation Study, University of Minnesota, Minneapolis 14, Minn.

Industrial Safety Institute

Date: Annual
Address: University of Tennessee, Knoxville, Tenn.

Safety Engineering

Date: April 11–15, 1960
Objective: To aid newly appointed safety supervisor as well as experienced safety engineer in accident prevention
Fee: $60.00
Address: M. L. Powers, Director, Bus. & Ind. Services, Extension Division, University of Oklahoma, Norman, Okla.

Safety Institute

Date: July, 1960
Address: University of Arkansas, Fayetteville, Ark.

Sanitary Engineering

Air and Water Pollution Conference

Date: November 17, 1959, annual
Objective: Discuss problems in the field
For: City officials, operators, engineers, industry, conservationist, laymen

Limitations: Largely Missouri
Fee: $5.00 (includes luncheon)
Address: College of Engineering, University of Missouri, Columbia, Missouri

Air and Water Pollution Conference
Date: November, 1959
Objective: Forum on problems in above topic
For: Private, municipal, and industrial water supply management
Fee: $5.00
Address: Dr. Amos J. Snider, Division of Continuing Education, University of Missouri, Columbia, Mo.

Arkansas Water and Sewage Conference
Date: March, 1960
Address: University of Arkansas, Fayetteville, Ark.

Industrial Wastes
Date: January 12–13, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Institute for Water and Waste Treatment Plant Operators
Date: September 8–10, 1959, 9:00 a.m. to 4:00 p.m., annually
Objective: To aid plant operators to operate plants better, safer and more economically
For: Plant operators
Limitations: None
Fee: $6.00 per person
Address: Director of Institutes, University College, University of Maryland, College Park, Md.

Operators of Water and Sewerage Systems, Short Course
Date: April 11, 12 and 13, 1960
Objective: Practical and technical information on system operation
For: Water and sewerage system operators
Limitations: None
Fee: Registration $5.00
Address: Frank E. Cotton, Jr., P. O. Box 245 (Miss. State U.), State College, Mississippi

Water and Sewage Operators Short Course
Date: January 25–30, 1960
Objective: Training operators of water and sewage plants
For: Operators
Limitations: Sponsored by Dept. of Civil Eng., Univ. of Missouri and Missouri State Board of Health
Fee: $3.00
Address: Dr. Amos J. Snider, Division of Continuing Education, University of Missouri, Columbia, Missouri

Water and Sewage Operators Short Course
Date: June, 1960
Objective: Instruction in the latest methods of water and sewage treatment
Fee: None
Address: Engineering Extension, Alabama Polytechnic Institute, Auburn, Alabama

Water and Sewage Plant Operators Short Course
For: In-Service water and sewage plant personnel from municipal treatment plants throughout Ohio
Fee: $15.00
Address: Prof. Waldron D. Sheets, Water Resources Center, Engineering Experiment Station, 156 W. 19th Ave., OSU, Columbus 10, Ohio

Water Conditioning

Date: May 26–27, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Water Supply Conference

Date: April 6, 1960
Objective: Discussion of some phase of water supply—Topic yet to be decided
For: Water supply managers and executives
Limitations: Sponsored by Department of Civil Engineering, Univ. of Missouri, and American Water Works Association
Fee: $5.00
Address: Dr. Amos J. Snider, Division of Continuing Education, University of Missouri, Columbia, Mo.

Space Problems

Clinic on Space Biophysical Measurement and Control

Date: October 26–27, 1959
Address: Mr. Loren Bollinger, Dept. of Aeronautical Engrg., Rocket Research Lab., 2240 Olentangy River Road, OSU, Columbus 10, Ohio

Space Education Institute

Date: Monday evenings, February 29–May 2, 1960; annually
Objective: To provide educators with space information not readily available in published form and relate science teaching to contemporary trends
For: Educational leaders, teachers, members of the American Rocket Society
Limitations: Registrations limited to one hundred fifty persons
Fee: $7.50 per person
Address: Director of Institutes, University College, University of Maryland, College Park, Md.

Space Research and Technology Institute

Date: Monday evenings, October 5–November 23, 1959; annually
Objective: To provide scientists with the opportunity to hear authorities in the various areas of space research
For: Physicists and engineers interested in such areas as propulsion, space flight, communications, and space medicine
Limitations: Registrations limited to two hundred persons
Fee: $35.00 per person
Address: Director of Institutes, University College, University of Maryland, College Park, Md.

Astrodynamics and Rocket Navigation

Date: Summer 1960
Objective: An introduction to the celestial mechanics of the rocket problem
For: Graduate, professional, fully employed engineers
Fee: $150.00 for two weeks
Address: University of California, Los Angeles, Engineering Extension, Engineering Building, Unit II, Room 6266

Surveying

Land Surveyors Conference (Seventh Annual)

Date: April 9, 1960
Objective: To bring surveyors together to discuss common problems. Develop better cooperation among group. Educational
For: Engineers interested in surveying and land surveyors

Limitations: State—some outside speakers
Fee: $5.00 registration fee
Address: Professor Philip B. Newlin, Civil Engineering Department, The University of Arizona, Tucson, Ariz.

Surveyors

Date: December 2–4, 1959
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Surveyors Conference

Date: February 10, 1960—Annual
Objective: Solution of "legal-related" and surveying problems
For: Land surveyors
Limitations: Iowa
Fee: $10.00
Address: Engineering Extension, Iowa State University, Ames, Iowa

Testing and Standards

Engineering Standards

Date: May 5–6, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Non-Destructive Testing

Date: January 7–8, 1960
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Summer Conference Course: Fundamental Principles of Nondestructive Testing

Date: September 14–25, 1959—annually
Objective: Pre-service and in-service
For: Engineers, management, and high-level operators in industry requiring basic training to use nondestructive tests effectively
Fee: $175.00
Address: Dr. R. C. McMaster, Dept. of Welding Engrg., 134 Industrial Engr. Bldg., 190 W. 19th Ave., OSU, Columbus 10, Ohio

Tool Engineering

Space Age Tooling Seminar

Date: November 13–14, 1959 (first conference; if successful may be repeated)
Objective: To promote the recognition of tool engineering and future tooling problems on an industrial and educational basis
For: Technical personnel in the industrial, educational and pre-graduate fields
Limitations: Regional, encompassing Rocky Mountain and West Coast areas
Fee: Approximately $10.00 registration fee
Address: J. Clark Pierce, Chapter Chairman, ASTE Chapter 106, P. O. Box 11431, Emery Park Station, Tucson, Ariz.

Tool Engineering

Date: October 29–30, 1959
Fee: $25.00 (typical)
Address: Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wis.

Tool Engineering Seminar
Date: November 5 and 6, 1959
Objective: Tool engineering for Mississippi
For: Industry and university faculty and students
Limitations: None
Fee: Registration $10.00
Address: Frank E. Cotton, Jr., P. O. Box 245, State College, Mississippi (Miss. State U.)

Tooling and Manufacturing Conference, On-Campus
Date: November 6–7, 1959
Objective: Discussion of manufacturing procedures in the metal working industries
For: Industrialists, tool engineers, technicians, and college students
Limitations: Statewide
Fee: $15.00 before November 1; $17.00 after November 1
Address: College Extension Division, P. O. Box 5125, State College Station, Raleigh, N. C.

Traffic Engineering

Traffic Engineering Conference, Twelfth Annual
Date: May 12 and 13, 1960
Objective: Study and discrimination of information on traffic problems
For: Private, city, county, state and federal level traffic administrators
Fee: $5.00
Address: Dr. Amos J. Snider, Division of Continuing Education, University of Missouri, Columbia, Missouri

Traffic Engineer's Conference
Date: Nov. 18–19, 1959
Objective: A 2-day conference for practicing engineers on one specific topic of current interest
For: Prof. engineers interested in design and operation of traffic facilities
Limitations: None
Fee: $5.00 per person
Address: C. J. Keese, Prof. Civil Eng. Dept., Texas A. and M. College, College Sta., Texas

Ventilation

Industrial Ventilation Conference
Date: February 15–18, 1960–Annual
Objective: Promotion of good ventilation practices and design techniques throughout U. S. and Canada. Up-to-date talks on ventilation design problems on exhaust ventilation, mining ventilation
For: Engineers, contractors, manufacturers, government and hygenic engineers
Fee: $40.00
Address: Michigan State University, East Lansing, Mich.

Industrial Ventilation Conference
Date: March 21–24, 1960 (annual event)
Objective: To promote good ventilation practices and design techniques throughout industry
For: Beginning and advanced designers of industrial ventilation
Limitations: National
Fee: Conference tuition–$35.00 per person
Address: College Extension Division, P. O. Box 5125, State College Station, Raleigh, N. C.

VISITING FACULTY OPPORTUNITIES

Visiting faculty opportunities in engineering education are available at twelve universities as part of the new Ford Foundation program in science and engineering. Applications should be made directly to the institutions, not to the Foundation.

The purpose of the program is to strengthen the ranks of engineering teachers and enhance the quality of experimental curriculum approaches. About $2 million has been earmarked for this purpose over the next five years.

Grants were made to nine institutions * to enable faculty members at other schools (not having the goal of an advanced degree) to better themselves professionally. Emphasis is on the significance of the proposed activity to the individual and on his later influence on his home campus. The faculty member may go to the host institution to do independent study, research, library work, work with a given professor, or refresher courses. His tenure may be for a summer, semester, or year. The faculty member may initiate the application, and final arrangements are worked out jointly between himself, his dean, and the dean at the school selected for supplemental work who has jurisdiction of the funds. It is hoped that the home institution will bear part of the cost.

Grants were made to seven institutions for projects for educational experimentation pointed towards curriculum development. The grants encourage participation by visiting staff members from other schools and industry not having the goal of an advanced degree. Faculty members from other institutions may participate at their current salary plus directly related expenses. A visiting faculty member may participate in the initial stages of the developments by teaching sections of new courses and learn the approaches and developments to carry back to his home institution. The interested faculty member may initiate the application. Selection and arrangements will be handled solely by the host institution with leave-of-absence concurrence of one's own administration. Specific orientations differ at the several schools and these are briefly described below.

Massachusetts Institute of Technology—development of science-based, interdepartmental undergraduate core courses.

University of California (Los Angeles)—development of design-based undergraduate and graduate courses and strengthening of the unified curriculum; strengthening of the research discipline in the engineering graduate program.

University of Michigan—use of computers in instruction in all departments and at all levels to open up the opportunity of a fresh and deeper approach to engineering education.

Case Institute of Technology—development of interdepartmental teaching and research activities in engineering at both the undergraduate and graduate levels within the framework of an Engineering Design Center and a Systems Research Center.

Carnegie Institute of Technology—further development in breadth of a creative laboratory-problem teaching approach. This approach is directed toward helping the student develop initiative and creative skills in applying basic science to new professional problems in a wide variety of disciplines.

University of Cincinnati—extension of the industry-university cooperative progam of engineering education to the doctoral level, with industry-sponsored fellowships. This approach utilizes for the dissertation fundamental research problems of mutual interest to the university and industry, and employs the best personnel and best facilities of each.

California Institute of Technology—in graduate level engineering education an evaluation of the appropriate relative effort in engineering synthesis instruction as compared with engineering analysis.

* California Institute of Technology, University of California (Berkeley), Carnegie Institute of Technology, University of Illinois, Massachusetts Institute of Technology, University of Michigan, Purdue University, Stanford University, and University of Wisconsin.

What's Going On in ASEE

ECAC Annual Report, July 1, 1958–June 30, 1959

A. *Officers and Committees.* Officers of the Engineering College Administrative Council for 1958–59 were: Chairman, R. A. Morgen, Purdue University; Secretary, H. E. Wessman, University of Washington.

Executive Committee members were: Dean A. T. Granger, University of Tennessee; Dean R. H. Roy, Johns Hopkins University; Vice President G. B. Carson, Ohio State University; Dean Lee H. Johnson, Tulane University; Dean G. H. Marston, University of Massachusetts.

Committee Chairmen were: International Relations–Professor J. G. Young, University of Michigan; Manpower–Donald L. Pyke, Ramo-Wooldridge Corporation; Military Affairs–Dean Lee H. Johnson, Tulane University; Secondary Schools– Professor A. R. Spalding, Purdue University; Selection, Guidance and Placement–Professor A. Pemberton Johnson, Newark College of Engineering; Accreditation by Individual States–Dean E. C. Easton, Rutgers University.

B. *Executive Committee Meetings.* The Executive Committee held its fall meeting on November 13, 1958, in the Willard Hotel, Washington, D. C. The minutes of this meeting were distributed to the membership in Bulletin XXVII, dated January 1959.

A luncheon meeting of old and new members of the Executive Committee and committee chairmen was scheduled for Thursday, June 18, at Pittsburgh.

C. *Nominations and Election.* At the June 1958 Executive Committee meeting at California, a Nominating Committee consisting of the following members was appointed: E. C. Easton, Chairman, W. L. Everitt, and J. H. Lampe. This committee proposed the following slate of officers and new members for the Executive Committee: H. E. Wessman, University of Washington, Chairman; W. P. Kimball, Dartmouth College, Secretary; T. H. Evans, Colorado State University, and L. R. Quarles, University of Virginia, members of Executive Committee. These gentlemen were elected to office by letter ballot sent to 155 institutional representatives. They will hold office for the next two years and their terms of appointment begin at the close of the Pittsburgh meeting.

D. *Committee Activity.* A brief summary of each committee report for 1958–59 is submitted herewith. The complete report of each committee is in the files of the Secretary, ECAC.

1. *Committee on International Relations*–J. G. Young, Chairman. The Committee sponsored an interesting conference at the ASEE meeting on June 19, 1958, at Berkeley. Papers were presented on engineering education in Indonesia, Europe, and India. The Committee will also stage a conference at Pittsburgh on the theme "Adopting American Education to the Needs of Technical Students From the Rapidly Developing Countries."

Two major projects have been considered by the Committee this year. The first was proposed by Dr. W. R. Weems of MIT for "A Study of American Aid to Engineering Education Abroad." The project is being held in abeyance pending the availability of a qualified person since Dr. Weems is not currently available. The second project is "A Study of Practical Experience Training for Foreign Students in the United States." This project is being sponsored by the RWI Steering Committee and has been submitted to the Executive Board of ASEE for consideration. Steps are also being taken to coordinate the activities of this committee with the EJC Committee on International Relations.

2. *Committee on Manpower*–D. L. Pyke, Chairman. The Committee sponsored a conference at Berkeley on developments affecting the supply of and demand for engineers and scientists. It

also presented a report to the Executive Committee at the November meeting in Washington on the enrollment situation. Statistics compiled by Henry Armsby of the U. S. Office of Education were presented and discussed at that time. It is of interest to note that the reasons for the drop in freshman engineering enrollment which were presented at that time are essentially the same as the reasons presented in the recent report released by the Engineering Manpower Commission of Engineers' Joint Council.

The Committee is planning a closed breakfast meeting at Pittsburgh.

3. *Committee on Military Affairs*—L. H. Johnson, Chairman. No matters pertaining to military affairs in engineering education were referred by any organization or person to the Committee during the year 1958–59. Accordingly, no actions were taken. This committee does not have the function of initiating action but rather to act in response to problems or questions which arise from other sources and which are directed to ASEE.

4. *Committee on Secondary Schools*—A. R. Spalding, Chairman. The Committee has given some study to the question of recommending that the engineering profession coordinate all high school career counseling. This would include local sections of ASEE, admission directors of neighboring engineering colleges, and the state guidance director. However, at the Washington meeting of the Executive Committee in November, 1958, it was believed that this question was primarily a matter for the Selection and Guidance Committee. Consequently, a joint breakfast meeting of the two committees will be held in Pittsburgh in the interest of coordination. Two additional questions explored by the Committee are as follows: should the Committee go on record as approving a high school curriculum strong in all areas, not just in mathematics and science? Should the Committee recommend that the profession discourage the teaching of advanced standing courses such as analytical geometry or calculus to high school students who have not acquired the basic disciplines in arithmetic, geometry and algebra? These two questions are to be discussed at the Friday morning meeting of ECAC institutional representatives in Pittsburgh.

5. *Committee on Selection, Guidance and Placement*—A. Pemberton Johnson, Chairman. Close liaison has been maintained by this committee with the ECPD Guidance Committee and its Chairman, General L. G. Smith of Baltimore. The two committees offered assistance to 305 directors of NSF summer institutes for science teachers in arranging visits illustrating uses of mathematics and science in industry. The Committee has also recommended to deans of engineering colleges that they offer assistance to the state commissioners of education in connection with the expansion of statewide guidance activities under Title V of the National Defense Education Act.

The Committee is sponsoring a conference at Pittsburgh at which a report will be presented about the research project conducted by Educational Testing Service on engineering graduate placement. A subcommittee of the Committee headed by D. S. Bridgman will report on dropout trends at the Friday meeting of ASEE institutional representatives in Pittsburgh.

6. *Ad Hoc Committee to Study Accreditation by Individual States*—Elmer C. Easton, Chairman. This Committee has successfully concluded its work by negotiating an agreement with the New York State Education Department under which the State of New York will use accreditation by ECPD as a basis for registration of engineering curricula. The ECPD and the New York State Education Department have both agreed to follow the procedure indicated in Plans A and B as outlined in the Appendix to this report.

E. *Federal Legislation.* The ASEE Committee on National Legislation under the chairmanship of H. K. Work, New York University, reports that most of the proposals in Congress relating to educational matters are not directly the concern of ASEE. There has been some talk of amending the National Defense Education Act. There are also various pro-

posals relating in various ways to engineering but there is little indication that these will pass Congress. However, a commission to study the desirability of establishing a Federal Department of Science and Technology may possibly be authorized by Congress. The President and Vice President of Engineers' Joint Council have been active in submitting pertinent recommendations to the Senate Committee headed by Senator Humphrey which is considering the implementing legislation.

F. *Committee on Relations with National Science Foundation.* Although this Committee under the chairmanship of Dean R. H. Roy reports directly to ASEE, its work is of definite interest to the heads of the engineering schools. This Committee has been very active and has prepared an excellent report which will subsequently be distributed to institutional representatives. It will also be briefed at the meeting of institutional representatives in Pittsburgh.

G. *Executive Committee Bulletins.* The following Bulletins were distributed during the year: Bulletin XXVI, October 1, 1958, Bulletin XXVII, January 1959, and Bulletin XXVIII, May 1959.

H. *Program for the Pittsburgh Meeting.* Program events sponsored by the ECAC have been published in Bulletin XXVIII and also in the ASEE Program for the 67th Annual Meeting. Details will not be repeated in this report. It is believed however that the meeting for institutional representatives on Friday, June 19, will be of particular significance in pointing the way for closer cooperation between engineering educators and the National Science Foundation.

Respectfully submitted,

HAROLD E. WESSMAN,
Secretary

ECRC Annual Report for 1958–59, June 12, 1959

The Engineering College Research Council enjoyed another full and productive year thanks to the effective efforts of our secretary, R. Contini, and the uniformly careful, imaginative and hard work of each of the chairmen of our committees. The Executive Committee held two meetings since the last annual convention, on November 13 in Washington, D. C., and on February 27 in Chicago, Illinois.

Hightlights of the year include:

1. *New Members.* Admitted during the year were:

University of Cincinnati
Colorado School of Mines
University of Houston
New Mexico College of A. and M. Arts
Drexel Institute of Technology

2. *1959 Research Review.* Publication of this volume is now a joint venture of the Secretary of ECRC and the Editor of the JOURNAL. Some of the detailed listings have been eliminated, report format has been simplified, size has been reduced, and it is hoped printing costs will thereby be reduced and value of the publication enhanced. Copy should go to the printer shortly.

3. *Relations with Industrial Research Agencies.* The committee, under the chairmanship of Clark A. Dunn, has developed a manuscript entitled Research Relations Between Engineering Educational Institutions and Indusrial Organizations. The Small Business Administration of the Department of Commerce has expressed great interest and has agreed to publish the report as the Small Business Management Series No. 23 at no cost to the Society. ECRC and ASEE will be identified as sources and the authors will be credited. A summary of the report will be published in the JOURNAL.

4. *Relations with the Federal Government.* Substantial activity has continued during the year by this committee under the chairmanship of H. R. Warfield. The principal consideration has related to Circular A-21 of the Bureau of the

Budget. On November 13, 1958, the following resolution was adopted by the ECRC Executive Committee on recommendation of the study committee.

Resolution of the Committee on Relations with the Federal Government of the Engineering College Research Council Adopted 12 November 1958 (as modified by ECRC Executive Committee 13 November 1958)

Whereas the Bureau of the Budget has issued Circular A-21 dated September 10, 1958 to the Heads of Executive Departments and Establishments of the Federal Government, covering principles for costing research and development under grants and contracts with educational institutions and

Whereas at a meeting on November 12, 1958 of the Engineering College Research Council Committee on Relations with the Federal Government it was unanimously agreed that Circular A-21 still contains points to which major objections were raised on behalf of colleges and universities, including the ECRC, by the American Council on Education to the Director of the Bureau of the Budget on June 23, 1958; and

Whereas the ECRC Committee, in its capacity of representing the interests of advancing and facilitating engineering college research of importance to the nation is particularly concerned about the separation of research and instruction which may be forced by emphasis on space utilization as a means of allocating operation and maintenance expenses and use charges between instruction and research; and

Whereas the ECRC Committee has been advised of a resolution with respect to Circular A-21 adopted by the Standing Committee on Government Relations of the National Federation of College and University Business Officers Associations;

Now therefore

1) The ECRC Committee urges that in the development of implementing instruction and interpretation for Circular A-21 every effort should be devoted to improving and optimizing the effectiveness and capabilities of educational institutions to perform research and development with full recognition of the inseparability of research an instruction in our educational institutions.

2) The ECRC Committee on Relations with the Federal Government endorses the proposal by the Standing Committee on Government Relations of the National Federation of College and University Business Officers Associations to the effect that the various Federal Agencies defer the issuance of implementing instruction for Circular A-21 until pilot studies can be completed to ascertain the feasibility of applying these instructions and what impact these instructions will have.

3) The ECRC should cooperate in the pilot studies being made in particular through the cooperation of the research administrators at the several pilot study institutions with the business officers of those institutions and the local government auditors.

4) The ECRC Committee strongly recommends, as did the Business Officers Committee, that all Federal Agencies, including the National Science Foundation and the Department of Health, Education and Welfare, sponsoring research and development work at educational institutions should adopt the principles and implementing methods finally agreed upon.

• • •

Resolution of the Standing Committee of the National Federation of College and University Business Officers Associations

Whereas the Bureau of the Budget has issued Circular A-21 dated September 10, 1958, to Federal Agencies with a request to receive by letter from said agencies on or before November 30, 1958, the extent to which the provisions of this circular have been placed in effect, and include copies of any internal instruction issued,

Whereas the Circular was issued over the major objections to specific points as presented by the American Council on Education representing the position of the colleges and universities, on June 23, 1958 to the Director, Bureau of Budget,

Whereas a meeting of the Standing Committee on Government Relations of the National Federation of College and University Business Officers Associations was held in Chicago on October 23, 1958, to discuss the impact of this circular upon the educational institutions, attended by representatives per attached list,

Whereas it was the unanimous opinion of this group that the representatives of colleges and universities continue to hold substantially to the same objections expressed at the June 23, 1958 meeting, and, in addition, have great uncertainty as to how this Circular can and will be applied, and

Whereas it is understood that various Federal Agencies are studying implementation of the Circular

Now therefore

1) We, the members of the Standing Committee on Government Relations of the National Federation of College and University Business Officers Associations, have agreed to make pilot studies to ascertain the feasibility of applying these instructions and what the impact of these instructions will have upon higher education,

2) We propose to complete these pilot studies prior to February 1, 1959, and will be prepared to discuss these studies with the Bureau of the Budget and other Federal Agencies immediately following that date,

3) We recommend that the various audit agencies of the Government be authorized to cooperate with the colleges and universities while these pilot studies are being carried out,

4) We recommend that the various Federal Agencies defer the issuance of implementing instructions until colleges and universities have had an opportunity for detailed discussions with the agencies covering the results of their pilot studies,

5) We recommend that all Federal Agencies, including the National Science Foundation and the Department of Health, Education and Welfare, sponsoring research and development work at educational institutions should adopt the principles then agreed upon, and

6) We urge that this Resolution be endorsed by the Engineering Colleges Research Council, the Association of American Universities, and the American Association of Land-Grant Colleges and State Universities, and that the American Council on Education present this resolution to the Director of the Bureau of the Budget.

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At this annual meeting the Tuesday afternoon program will be devoted to a discussion of the effects of Circular A-21. Ten universities have cooperated in a pilot study of the possible effects and reports will be presented, after which further appropriate action will be determined.

5. *Annual Meeting Program.* Under the able leadership of C. C. Chambers a stimulating program has been developed for this year. The Tuesday session under the chairmanship of H. R. Warfield will be concerned with Principles for Determining the Allowable Costs for Research and Development.

As usual ECRC and ECAC will have a joint dinner on Tuesday evening at which the ASEE Industrial Fellowships will be awarded. Hugh L. Rusch, Vice-president of the Opinion Research Corporation, will be the speaker.

Wednesday, instead of a General Session, has been given over entirely to inspection trips to plants and research facilities for the entire membership of the Society. This new venture, representing a radical departure from former programs, has meant a great deal of work for the committee. The results and reception by members will be evaluated with great interest. The ECRC section will visit Mellon Institute and will begin the day's program with a panel under the chairmanship of M. A. Williamson on Controversial Issues in the Research

Relations Between Engineering Colleges and Industrial Organizations.

The Thursday session will be a joint session with the Graduate Studies Division under the chairmanship of N. A. Hall. Topic: Graduate Theses in Sponsored Research.

The Executive Committee of ECRC will hold at least two sessions during the annual meeting.

6. *Survey of Research Capabilities.* The special committee under the chairmanship of Eric A. Walker has completed its task. Some 3,000 copies of the report are still available to interested members. An unexpended balance of about $5,000 in the fund for this work has been returned to the National Science Foundation, and the committee is discharged with the thanks of ASEE for a large and difficult task well done.

7. *Awards.* The Executive Committee has suggested that the dates for preliminary nominations and for the completely documented nominations for both the Vincent Bendix Award (L. H. Johnson, chairman) and the Curtis W. McGraw Award (W. J. Seeley, chairman) be advanced to January 1 and February 1, respectively. This will permit report to and confirmation of nominees by the Executive Committee at its regular late February meeting.

The design for the certificates to accompany the awards was approved and two-color certificates will be presented in the future.

8. *Research Administration.* This committee, under the chairmanship of H. W. Barlow, has undertaken a new and large task in the form of a project: Research on "The Education of Engineers." The committee's function is to serve as a catalyst in this important phase of the Society's responsibilities. In November, the Executive Board of the Society approved an advance of $1,500 to cover costs of meetings of the committee augmented by representatives from ECAC, Educational Methods Committee, CDEF, and the Graduate Studies Committee. The augmented committee met twice and is in the process of drawing up proposals for research studies. In April the Executive Board directed that the Vice President for ECRC be responsible for the preparation of a proposal to request funds from the National Science Foundation for planning such programs, and that he serve as the representative of the Executive Board in the solicitation of funds from NSF. In subsequent action, when the interest of the Ford Foundation in engineering education was reported, the Board authorized President-elect Teare to proceed with negotiations with the Ford Foundation for a sum not to exceed $25,000 to be used to meet the expenses of a select committee to prepare a proposal for a comprehensive study of the problems in engineering education.

It was agreed that whatever projects are developed would be Society projects and would be carried out by the group or groups deemed most appropriate by the Executive Board. Dr. Barlow is to be given a few minutes on one of the general sessions to call the entire study to the attention of the membership.

9. *Nominations and Elections.* The report of the Nominating Committee (R. J. Woodrow, chairman) was duly presented and the slate was elected. New officers for 1959–60 are:

Junior Vice Chairman:
Ross J. Martin
University of Illinois

Directors:
F. Leroy Foster
Massachusettes Institute of Technology
L. H. Johnson
Tulane University

I take this opportunity to thank the many members of committees, the chairmen, and our secretary for their interest and their extended efforts. Without their dedicated service little progress would be possible.

Respectfully submitted,

KURT F. WENDT,
Vice President for ECRC

Report of the ASEE Editor for 1958–1959

Volume 49 of the JOURNAL for the publishing year 1958–59 contained a total of 1,008 pages of editorial material, the largest number of pages ever published in a single JOURNAL volume. This total was the result of publishing a set number of pages in each issue (96) plus the publication in the May issue of the final report of the ASEE Mission to Russia as extra pages beyond the standard 96. In October the 96 pages included the 59 page "Report on the Engineering Sciences."

Even with this number of pages, the JOURNAL was able to publish only a small proportion of the papers submitted. Of a total of 736 papers submitted during the year or on hand when the present editor entered on his duties, 116 have been published, 370 have been returned to the authors, and 230 are still awaiting action. Of the total of 736 papers, 415 came from other sources than the annual meeting.

To help the Editor select the very best from this plentiful supply of papers, the Executive Board at its spring meeting authorized the creation of an Editorial Committee, to be made up of a representative of each division, council, or other, similar group in the Society. With a good supply of high quality papers to choose from, and with the aid of the Committee, the JOURNAL should more and more be able to speak clearly and effectively for all phases of engineering education.

The staff of the JOURNAL during the year has consisted of an editor half time, an increase from the 20% time of the previous editor, and a secretary full time. This represents more staff time than has previously been available to the JOURNAL. This staff has handled all editorial matters (with the exception of the Yearbook-Directory), those production details not taken care of by the printer, and all aspects of the advertising, including soliciting and billing. Since both members of the staff were new to the JOURNAL this year, new policies and procedures have been developing month by month. Routines have been established, mistakes have taught their lessons, and we hope to be able to offer steadily improving service to our readers, contributors, and advertisers. During the year every issue was published within the month of its publishing date. We are mildly proud of this, but we hope this next year to get every issue out early in the month of its publishing date, preferably by the first.

One of the highlights of the past year was the featuring of nuclear engineering in the February 1 issue. Some colleges of engineering were sufficiently interested to request extra copies for distribution to their staff and students. Financially the issue was something of a success in that it attracted more pages of advertising (20) than any other single issue during the year. Similar special feature issues are being considered for the future.

A total of 10,687 copies of the JOURNAL, plus 525 for the PROCEEDINGS, were printed for October of 1958, our first issue of this volume. By comparison, 9,464 copies plus 500 for the PROCEEDINGS were printed in October of 1957. The total cost of printing and mailing the JOURNAL in 1958–59 (estimated) was $40,950, as compared with a total cost for 1957–58 of $37,908.

Advertising for this year started at 17 pages in the October issue, rose to a high of 20 pages in February, then declined to a low of 11 pages in the June issue. The total number of pages of advertising for this year was 162½, as compared to 180 for the previous year. Part of this decline is attributable to the rise in our advertising rates that went into effect in January of 1958, but not all of the decline can be accounted for in this way. Because of the rate increase, advertising income was up slightly this year from last: estimated $25,041 for 1958–59 as compared with $23,936 in 1957–58. Still, the trend over the past two years is in the wrong direction in terms of numbers of pages. A vigorous campaign to interest more companies in JOURNAL advertising is now under way in the hope of improving this important source of revenue. We are hoping that the mem-

bers of the Society will find ways to help us impress manufacturers, publishers, and others with the JOURNAL as an effective advertising medium.

The Teaching Positions Available advertising, open to institutional members of ASEE, has shown a similar trend. From a total of 1,034 lines in 1957–58, this advertising dropped to 1,007 lines in 1958–59, with a corresponding drop in revenue.

An additional duty undertaken by the Editor during the year has been the providing of editorial help in the publication of the 1959 *Engineering College Research Review*. This job is still in midstream. Other activities of the Editor during the year included the editing of the final report of the ASEE Mission to Russia and the editing of the technical writing section of the PROCEEDINGS of the National Electronics Conference.

Two visits were made to Lancaster Press, the printers of the JOURNAL, in Lancaster, Pennsylvania. One was made in September of 1958 and the second in April of 1959. Both visits were quite fruitful in working out improved procedures.

The April trip to Lancaster was coordinated with the Editor's attendance at the annual meeting of the Council of Engineering Society Secretaries in Atlantic City. The Editor attended in place of the Secretary, who was unable to be there. This was a very worthwhile meeting at which the staff members of the engineering societies got better acquainted and exchanged views and ideas concerning society operations. The Editor also attended the winter meeting of the Directors of the Engineering College Research Council in Chicago, at which time the *Research Review* was discussed, and the final meeting of the Russian Mission Group, also in Chicago. Finally, the Editor attended the spring meeting of the Illinois-Indiana section of ASEE.

Respectfully submitted,

PAUL T. BRYANT,
Editor for the Society

NEW RESEARCH INSTITUTE AT MICHIGAN

Michigan's Institute of Science and Technology moved a big step forward July 24 as the Regents of The University of Michigan approved a set of bylaws, adopted a budget and appointed a director. Named to the top post as director of the institute was 43-year-old Robert R. White, associate dean of the College of Engineering and a professor of chemical and metallurgical engineering.

The $500,000 budget for the institute, which will carry out a program of supporting and encouraging "frontier area" research in science and technology, is covered by an appropriation made by the State of Michigan.

POSTDOCTORAL STUDY IN STATISTICS

Awards for study in statistics by persons whose primary field is not statistics but one of the physical, biological, or social sciences to which statistics can be applied are offered by the Department of Statistics of the University of Chicago. The awards range from $3,600 to $5,000 on a nine months' basis. The closing date for application for the academic year 1960–61 is February 15, 1960. Further information may be obtained from the Department of Statistics, Eckhart Hall, University of Chicago, Chicago 37, Illinois.

NEW PH.D. PROGRAMS AT ARKANSAS

A Ph.D. program in engineering was initiated at the University of Arkansas's College of Engineering in September, 1959.